

**DOCUMENTATION FOR THE 1996 BASE YEAR NATIONAL TOXICS
INVENTORY FOR AREA SOURCES**

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Distributed by:

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June 2, 2000

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1.0 INTRODUCTION

1.1 What Is the National Toxics Inventory?

The National Toxics Inventory (NTI) is a national repository of estimated emissions and supporting data for hazardous air pollutants (HAPs) and their sources. It has been created by the Emission Factor and Inventory Group (EFIG) of the U.S. Environmental Protection Agency (EPA) in Research Triangle Park, North Carolina. The original version of the NTI uses a 1993 base year, and it will be used as the baseline to track changes in HAP emissions nationwide. The 1996 base year NTI will be used to support air quality modeling and other activities. The NTI is made up of major source facility-specific data, mobile source data, and area source data. This report presents an overview of how the final area source component of the 1996 NTI was compiled.

1.2 Why Did the EPA Create the NTI?

The Clean Air Act (CAA), as amended in 1990, includes many mandates for the EPA related to HAPs. The CAA presents a list of 188 HAPs (see <http://www.epa.gov/ttn/uatw/188polls.txt> for a list of pollutants and their chemical abstract service (CAS) numbers), for which EPA is to identify these pollutants' sources, quantify their emissions by source category, develop regulations for each source category, and assess public health and environmental impacts after the regulations are put into effect. The NTI is a tool that EPA can use to meet the CAA mandates.

1.3 How Is the EPA Going to Use This Version of the NTI?

It is anticipated that the area source portion of the NTI will have multiple end uses. The initial objective is to make the data available to EPA modelers for use in the National Air Toxics Assessment. In addition, the emissions data compiled as part of this inventory effort will be used

to prepare the air toxics portion of the annual EPA publication entitled *National Air Quality Emissions Trends Report*, which is referred to as the EPA Trends report.

1.4 Report Organization

This report is organized in the following structure:

- Section 1. Provides background information on NTI and its uses;
- Section 2. Describes in general terms how the area source NTI was developed. The discussion covers inventory planning, emission estimation, and data management;
- Section 3. Describes how to interpret and use the area source NTI results, including a discussion of the inventory limitations;
- Section 4. Provides the references used in the previous sections;
- Appendix A. Lists the area source categories whose emissions were calculated by the NTI area source team and documents how area source emission estimates were developed;
- Appendix B. Lists the Maximum Achievable Control Technology (MACT) source categories included in the 1996 area source inventory, the source of the emissions information, the year of the emissions, and other useful notes;
- Appendix C. Lists the Toxic Release Inventory (TRI) source categories included in the 1996 area source inventory; and
- Appendix D. Describes the approach and data used to spatially apportion the national emission estimates in the area source NTI to create county emission estimates.

2.0 DEVELOPMENT OF THE AREA SOURCE NTI

2.1 What Are Area Sources?

Area sources are stationary sources of emissions that are too small and diffuse to be inventoried as individual sources. Based on their HAP emissions, area sources are defined as facilities or processes that have emissions below the major source threshold as defined in the CAA. According to the CAA, a major source is:

Any stationary source . . . that emits or has the potential to emit considering controls, in the aggregate, 10 tons per year or more of any hazardous air pollutant or 25 tons per year or more of any combination of hazardous air pollutants.

Another distinction between major and area sources is how their emission estimates are developed. Facility-specific data are used to calculate emissions for major sources. Area sources typically use “top-down” methods to estimate emissions. Top-down methods use national-, regional-, or state-level information to estimate emissions, which are then allocated to the local level. These methods simplify and generalize in order to estimate emissions from many individual processes that are grouped as a single source category. State and local agency-supplied facility level data, including area source facilities that emit below the major source threshold are stored in the point source NTI.

2.2 What Information Is in the Area Source NTI?

The 1996 area source NTI includes 483 area source categories and 155 HAPs. Most of these source categories are from TRI-reported emissions. The TRI source categories are defined by 4-digit SIC codes and are more specific than most area source categories. Like other emission inventories, the area source NTI has limitations based on the availability of data for some HAPs and source categories. These limitations are discussed in Section 3 of this document, and it is important to review them before interpreting the area source NTI data.

As noted previously, the original version of the NTI has a 1993 base year. The most significant difference between the 1993 and 1996 area source inventories is that, where possible, improved emission estimation methods and emission factors were used to develop the 1996 estimates. These improvements mean that some source categories may be defined somewhat differently and estimates for more HAPs may be included for some source categories. In addition, in developing the 1996 inventory, an effort was made to adjust emission estimates for federal regulations that were in effect in 1996. On the national level, no area source regulations were in place in 1993.

Another change is in the source category list. The source category list used for the 1993 area source NTI was reviewed during the planning stage of the 1996 area source NTI, and potential overlaps in source category coverage were identified. Overlap usually occurs when the sources of emission information do not use the same title for similar categories, or emissions are calculated using the different methods. The following section discusses how the area source category list for the 1996 NTI was compiled.

2.3 How Were the Area Source Emissions Estimated?

The development of the 1996 area source inventory proceeded through these steps:

- Planning;
- Gathering information;
- Estimating emissions;
- Soliciting review by state and local air agencies and EPA Regional Offices of the draft inventory;
- Performing quality assurance (QA)/quality control (QC) checks; and
- Compiling the data into a single final inventory database.

The goal for the area source NTI was to compile as many HAP emission estimates for as many area source categories as possible. The planning phase focused on identifying source categories that could be included and data available for each source category that could be used to estimate emissions. In the planning phase, QA/QC needs were also identified, and decisions were made on the database structure that would be used to compile and store the inventory data.

The data-gathering phase focused on four primary sources:

- Data provided to EFIG by state and local agencies;
- Data provided by the EPA's ESD for categories with area source emissions that currently are or will be regulated under the EPA's MACT program;
- Emission factors and activity data used by EFIG to calculate emissions; and
- Data obtained from the TRI for facilities reporting emissions below the major source cutoff that were not covered in any of the other data sources.

The area source categories included in the 1993 NTI were used as the starting point to identify source categories to include in the 1996 inventory. In the draft inventory, emission estimates provided by ESD were given priority. Some state and local data were available and used in the draft preparation phase of the inventory, and these data were used when they provided greater detail than was available from the allocated national emissions. In the final inventory, data from twenty six state and local air agencies were incorporated. The air agencies providing area source data revisions are listed in Table 2-1. Emissions data provided by state and local air agencies superceded any emission data provided by other information sources. EFIG also collected emission and activity factors, and calculated national-level estimates for other area source categories. TRI data were used to fill any gaps from area sources that report to TRI.

Table 2-1**States and Localities Providing Area Source Information for the NTI**

State or Local Agency
Alaska Department of Environmental Conservation
California Air Resources Board
Lake County, California, Air Quality Management Division
Monterey Bay, California, Unified Air Pollution Control District
Colorado Air Pollution Control Division
Connecticut Department of Environmental Protection
Delaware Department of Natural Resources
Florida Department of Environmental Protection
Hillsborough County, Florida, Environmental Protection Commission
Pinellas County, Florida, Department of Environmental Management Air Quality Planning
Illinois Environmental Protection Agency
Louisiana Department of Environmental Quality
Maine Department of Environmental Protection
Maryland Department of Environment
Massachusetts Department of Environmental Protection
Minnesota Pollution Control Agency
New Jersey Department of Environmental Protection
New York State Department of Environmental Conservation
North Carolina Division of Air Quality
Oklahoma Department of Environmental Quality
Oregon Department of Environmental Quality
Philadelphia, Pennsylvania, Air Management Services
Rhode Island Department of Environmental Resources - Air Resources
Tennessee Division of Air Pollution Control
Texas Natural Resource Conservation Commission
Utah Division of Air Quality
Washington Department of Ecology
Wisconsin Department of Natural Resources

The area source categories for which emissions were calculated are listed in Appendix A. This appendix also provides detailed descriptions of the methods, factors, and information sources used to calculate national emissions for these source categories.

Appendix B contains a table listing the MACT source categories included in the 1996 area source NTI. The emissions data for these source categories were provided by ESD, although in some cases, emissions data were developed from previous inventory efforts or compiled from the TRI according to instructions from ESD. Information is provided that indicates the base year of the estimates, the source of the data, and whether the data provided were national-level emissions or facility specific.

Emission estimates provided by ESD for MACT area sources were given priority in the draft area source NTI if the data represented the best available estimates for 1996. ESD data that had a base year other than 1996 were included in the inventory, but they were compared against other data sources to determine if they were the best data available and if they represented 1996 emission levels regardless of their base year.

Appendix C contains a table listing the Standard Industrial Classification (SIC) codes for which 1996 area source emissions data were obtained from TRI. TRI data were filtered to remove overlaps with MACT source category data and facility-specific data reported by the states.

2.4 What Adjustments Were Made to These Data?

Two common problems with area source inventories are: (1) double counting between facility-specific data collected and emission estimates calculated using area source methods; and (2) overlap between two area source categories. Resolving these issues required adjustments to the area source inventory data.

Facilities inventoried in the major source NTI are those that have been identified as major sources either by CAA standards (greater than or equal to 10 tons per year [tpy] for one HAP or greater than or equal to 25 tpy for multiple HAPs) or by thresholds set by state regulatory agencies. When data were reported by state and local agencies based on lower thresholds for facilities, the facility-specific data were still included in the major source NTI. Thus, some facility-specific emissions data received from ESD or obtained from TRI for inclusion in the area source inventory may have been already included in the major source inventory. A duplicate check was performed in order to avoid double counting of emissions. Facility-specific ESD and TRI emissions data were not included in the area source NTI if they were already included in the major source NTI.

A particular concern when compiling this inventory was source category overlap between two data sources. An example is the overlap between graphic arts, calculated using an area source method, and the MACT printing and publishing source categories. When source categories from different data sources with similarity in coverage were identified, data from only one of the sources were used in the area source NTI. Estimates for MACT-defined source categories took precedence over other data sources. In particular, TRI data were examined and were not included in the area source NTI for MACT facilities or processes.

Similarly, when the state or local agency-supplied data were determined to provide better estimates of emissions, these were incorporated into the area source NTI. In order to avoid double counting, emissions calculated by ESD and allocated to counties in a top-down approach were removed from the counties where the state-supplied data were used.

2.5 How Were Groups of HAPs Handled?

The CAA list of 188 HAPs includes several HAP groups in addition to individual chemicals. Examples of some HAP groups are metal compounds, cresols/cresylic acid (isomers and mixture), polycyclic organic matter (POM), dioxins, and furans. The area source NTI was

created so that information on the individual chemicals in these HAP groups could be retained, and their emissions could be reported either as the individual chemicals or as a combination of emissions that represent the entire HAP group. In the area source NTI, emissions for only the entire HAP groups are reported. The emissions data for the individual chemicals cannot be assumed to be complete, especially if there are readily available emission factors for only the entire HAP group.

For POM, emissions are summarized in the area source NTI as either the more general POM HAP group, or as two subsets of the POM groups that EPA developed for other national inventories. The first subset consists of 7 polycyclic aromatic hydrocarbons (PAHs), and the other consists of 16 PAHs. Individual POM chemicals that are not in either the 7-PAH or 16-PAH groups, or emissions defined simply as POM, are reported as POM in the area source NTI.

The compounds listed below constitute the 7-PAH (marked with asterisks) and the 16-PAH compounds. The 7-PAH compounds have been determined by the International Agency for Research on Cancer (IARC) to be animal carcinogens. The sum of these 7 compounds represents the 7-PAH emission subset that is used in this inventory, and the sum of the 16 compounds represents the 16-PAH emission subset used in this inventory.

Acenaphthene	Chrysene*
Acenaphthylene	Dibenz(a,h)anthracene*
Anthracene	Fluoranthene
Benz(a)anthracene*	Fluorene
Benzo(a)pyrene*	Indeno(1,2,3-cd)pyrene*
Benzo(b)fluoranthene*	Naphthalene
Benzo(ghi)perylene	Phenanthrene
Benzo(k)fluoranthene*	Pyrene

Thus, an estimate of the emissions for all of the POM compounds in the area source NTI is the sum of the 16-PAH and the POM emissions.

For dioxins and furans, emissions are presented as 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalents (TEQs), dibenzofurans, and total dioxin/furan. The dibenzofurans group is included in the CAA HAP list. Total dioxin/furan represents emissions of the remaining dioxins and furans retained in the area source NTI.

2.6 How Were the Emissions Allocated to the County Level?

The area source NTI was primarily compiled as a national-level inventory. National-level emission estimates were spatially allocated to the county level using a number of allocation factors, such as population and employment within certain industries. When state- or locally-specific emissions data were available, those data were substituted for data that had been allocated from national emission estimates. A detailed discussion of spatial allocation routines for source categories with national-level emission estimates is in Appendix D.

When ESD provided emissions data at the facility level, those data were assigned only to the counties where the facilities are located. Source categories with this level of detail are noted in the list of MACT categories in Appendix B. Data from TRI were also assigned only to the counties where the facilities are located. The TRI source categories are listed in Appendix C. State and local agency-supplied, county-specific data were also assigned only to the appropriate counties.

2.7 How Were the Inventory Data Compiled into the NTI Database?

One of the goals of this project was to process all of the inventory data into a common structure with consistently defined data fields. A common data structure can help end users of the inventory data define standardized approaches to using the data.

An essential part of this task was to format the data into a common structure so that the information could be easily defined and interpreted. It was decided that the EPA's Oracle[®]-based National Emissions Trends (NET) platform best served this purpose.

The specific data structure for the NET-Oracle[®] platform used for this project is based on the same model developed by the Data Management Committee (DMC) of the Emission Inventory Improvement Program (EIIP), a joint program involving EPA as well as state and local agency inventory scientists and engineers. The Data Model developed by the EIIP DMC is serving as the blueprint for the development of an electronic data transfer format that can be used to transfer data between individual facilities, state and local agencies, and the EPA. The Data Model was also designed to support all the emissions data needed for regional air quality modeling. More detailed information about the EIIP DMC Data Model, how it was designed, and what other options are available can be found in the documentation report for the Data Model development (EIIP, 1999a).

The area source NTI has been compiled in a Microsoft Access[®] database, and is configured so that it can be easily converted for use in the EPA's Oracle[®]-based NET platform. Area source NTI data elements are listed in Table 2-2. The Access[®] database was used to compile the data because it allows the use of text descriptions and more complete documentation of estimates and methods. Examples of the data stored in the database appear in Appendix A.

2.8 What Quality Assurance Procedures Were Used?

Quality assurance procedures used for this inventory covered five main preparation steps:

- Methods selection and data gathering;
- Emissions calculation;
- Data handling and transfer;

Table 2-2

Data Elements in the 1996 Area Source NTI

Data Element	Description
Revision Indicator	O = original from May 1999 A = new record added by state RA = revised record added by state
Inventory Year	Baseline year for inventory
State FIPS	2-digit FIPS state code
County FIPS	3-digit FIPS county code
County Name	Name that corresponds to 3-digit FIPS county code
Area Source Category Name	NTI source category name
SIC Code	Source category SIC code (when applicable)
EPA MACT ID	Source category MACT code (when applicable)
Pollutant CAS	Unique pollutant CAS number
Pollutant Name	Hazardous air pollutant common name
Record Number	Unique record ID
Emissions	Emissions estimate at county level
Emission Units	Units for county emissions estimate
SCC	Source category SCC code
AMS	Source category AMS code
Source Type	Source classification (e.g., Area sources)

- Identification and removal of overlaps; and
- Review of state-submitted revisions.

Methods selection -- Methods were researched and chosen based on previous work and the availability of emission and activity factors. Options for available data were identified. Decisions were peer reviewed before proceeding.

Emissions calculation -- All emission calculations were developed using spreadsheets and peer reviewed when complete. Samples of the emission calculations for each source category were verified using manual calculations.

Data handling and transfer -- Quality control checks were used to catch data handling errors at every major step of the process. Using spreadsheets and direct links to the database reduced the potential for errors in transfer.

Identification and removal of overlaps -- This inventory used data from multiple sources, so that the inventory could be as comprehensive as possible. Issues concerning double counting between data sources, between area source categories and between pollutants made up of multiple chemical species or congeners were first addressed as part of the inventory planning and approach. The overall approaches to these issues are discussed in this report in Sections 2.4 and 2.5.

Although some issues, such as multiple definitions of dioxin congeners, could be avoided by making simplifying decisions in the planning stage, other issues required painstaking review of the inventory data. Specifically, emissions from specific facilities obtained from ESD or TRI were compared to facility identifiers in the major source inventory in order to minimize double counting of facilities and their associated emissions.

Review of state-submitted revisions -- State and local agencies were asked by EFIG to provide comments and additional data for the area source inventory. As a result of this review process, state and local agencies submitted the following:

- Records designated for deletion from the draft inventory;
- Records designated for replacement with agency-provided emission estimates; and
- Records designated for addition to the draft inventory either in the form of additional pollutants emitted from existing source categories, or as new source categories not previously included in the draft inventory for a specific county.

The agency-submitted revisions were subjected to a rigorous QA/QC review process in order to ensure the internal consistency of the area source inventory. Specifically, the following steps were performed:

- Review documentation provided by state/local agency to ensure that it is consistent with the actual changes to the inventory submitted by the agency;
- Verify that the additional pollutants were HAPs;
- Verify that the additional pollutants are assigned the correct CAS number and vice versa;
- Verify that there is no source category overlap between the existing draft and revised state data;
- Verify that the add/revise/delete designations of the agency-submitted records during the review process are accurate (e.g., a record designated for addition is not in fact a revision to an existing record); and
- Perform reality checks on emission estimates, by source category and HAP, to identify outliers and determine the validity of such estimates.

3.0 INTERPRETATION AND USE OF THE 1996 AREA SOURCE INVENTORY

3.1 What Are the Limitations to the Source Categories Included Here?

General -- Area source inventories contain emission estimates for the smaller and more diffuse sources within a geographic area of study. Any area source inventory can have limitations, usually due to a lack of emission factors and activity data for some HAPs and source categories. Planning for this inventory began with compiling a list of potential area source categories. The primary resource for this list was the 1993 area source NTI. As the information-gathering phase progressed, some of the categories were dropped. Area source categories that were dropped are those for which there were no available emission factors or 1996 national-level activity factors, and categories that appeared to be very small contributors yet would require significant amounts of data collection to develop emission estimates.

State-supplied data – State-supplied emissions data have been given priority in the final version of the area source NTI. Although these submissions were reviewed by the EFIG for data handling and entry errors, and potential double counting, the estimation methods, the reliability of data sources and calculations, and other quality assurance issues were the responsibility of the preparing agency. The most immediate result of using large amounts of state-supplied data is that emissions from different states for the same source category may have been calculated using different methods. Although this diminishes the comparability of the data between states, it is likely to improve this inventory and future inventories by supplying EPA with local data and alternative estimation methods.

Non-1996 Data -- For some source categories, the necessary activity or emissions data were not available to compile 1996 estimates at the national level. In these cases, data for other base years were used. For some of these source categories, ESD provided emissions data for a year other than 1996 and noted that the data is nevertheless representative of 1996. For other source

categories, activity data or emission estimates from a different year were used that should approximate 1996. For MACT source categories, the draft MACT baseline inventory was used to fill these gaps (EPA, 1998). For non-MACT source categories, a variety of resources were used to best estimate emissions. Table 3-1 provides a list of the area source categories with data other than 1996. When state-supplied data was for a year other than 1996, it has been recorded in the database.

Categories not included -- Some area source categories may contribute HAPs, but could not be estimated at the national level in the 1996 area source NTI. Examples of these excluded categories are open burning of household and yard wastes, agricultural burning, and some metal mining processes. For the open burning and agricultural burning categories, national activity factors were not available. However, some states supplied estimates for the open burning source categories for their geographic area. Area source emission factors were not available for metal mining processes; however, starting in 1999, TRI reporting rules will require industries in the metal mining SIC codes to report emissions.

Coverage gaps -- For some source categories, there may be gaps in the coverage of pollutants or the available activity data may only partially represent the category. Notable examples are:

- Agricultural pesticides – National estimates were readily available for only one HAP (hexachlorobenzene) for this category. Estimates are needed for the other HAPs emitted. Data are also needed to allocate emissions based on pesticide application and other usage factors, rather than the surrogate approach used.
- TRI data – TRI data were used in this inventory, but there are a number of limitations associated with the use of the data that should be highlighted. For example, not all industrial facilities are required to report their emissions, only those with SIC codes 20 to 39. In addition, facilities are required to report their emissions only if they meet certain criteria. See the TRI reporting requirements for more details at <http://www.epa.gov/opptintr/tri> for more information.

Table 3-1**1996 NTI Area Source Categories That Do Not Have a 1996 Base Year**

Source Category Group	Year
Acrylic Fibers/Modacrylic Fibers Production	1997
Amino/Phenolic Resins Production	1992
Chromic Acid Anodizing	1990
Decorative Chromium Electroplating	1990
Dental Preparation and Use ^a	1990
Drum and Barrel Reclamation ^a	1990/1994
Flexible Polyurethane Foam Fabrication Operations	1993
Flexible Polyurethane Foam Production	1993
Fluorescent Lamp Recycling ^a	1990
Food and Agricultural Products: Cotton Ginning ^a	1995
Friction Products Manufacturing	1997
Gasoline Distribution (Stage I)	1998
General Laboratory Activities ^a	1990
Geothermal Power ^a	1992
Halogenated Solvent Cleaners	1994
Hard Chromium Electroplating	1990
Hazardous Waste Incineration	1997
Industrial Boilers	1994
Institutional/Commercial Heating (except wood)	1995
Lamp Breakage ^a	1990
Metal Can (Surface Coating)	1997
Mineral Wool Manufacturing	1994
Miscellaneous Organic Chemical Processes ^a	1995
Natural Gas Transmissions and Storage	1998
Oil and Natural Gas Production	1993
Paint Stripping Operations	1998
Pharmaceuticals Production	1990/1992
Polysulfide Rubber Production	1991
Polyvinyl Chloride and Copolymers Production	1990
Residential Fuel Use (except wood) ^a	1995
Softwood Drying Kilns ^a	1990
Steel Pickling Hydrogen Chloride (HCl) Process	1991
Taconite Iron Ore Processing	1989

^a Non-MACT Source Category Groups

- Open burning of scrap tires – The activity estimate for this category was very difficult to obtain and most likely over- or underestimates activity for a given state or county. For this inventory, a national activity data estimate was obtained based on expert judgement. National emissions were allocated to counties by the number of landfills in that county. This allocation surrogate was used to approximate true local activity, which is unknown. Many states provided local emissions estimates for this source category during the review phase. These revisions should improve overall emission estimates and emissions allocation for this source category. More accurate county- or state-level data are needed to improve the emission estimates for this category.
- Forest fires and wildfires – The readily available activity data for this category are incomplete. Emission estimates are currently based only on activity for federally managed or protected lands. Activity data are needed for state forest lands and private forests. In addition, estimated emissions are spatially allocated to the county level by the county's proportion of forested acres. This allocation surrogate was used to approximate true local activity, but local data would improve the overall estimation and location of emissions for this source category.
- Prescribed burning – The readily available activity data for this category are also incomplete. Emission estimates are currently based on activity for lands managed by the U.S. Department of the Interior and the U.S. Forest Service. Data were available for some but not all state forest lands. Activity data are needed for the remainder of the state forest lands and private forests. Prescribed burning emission estimates are also spatially allocated using forested acres as a surrogate of actual local activity. Local data would improve the overall estimation and location of emissions for this source category.

Category double counting -- If source categories overlap in their coverage of emissions, emissions will be double counted. This can be a particular concern if source categories have been defined in multiple studies, such as TRI, MACT source categories, or in EPA *Locating and Estimating* documents. Several steps were taken to avoid source category overlaps in the area source NTI, and these are discussed in Section 2.4 of this document.

Source categories need to be clearly defined so that they can be compared to other source categories. Some very typical area source categories such as industrial surface coating, graphic arts, and solvent cleaning are thus not included in the national level 1996 area source inventory. Emissions from these source categories are assumed to be addressed by the area source portions

of MACT source categories such as Plastic Parts and Products (surface coating) or Metal Can (surface coating) for industrial surface coating, Printing/Publishing (surface coating) for graphic arts, Halogenated Solvent Cleaners for solvent cleaning, and as part of the reported emissions for multiple industries that report to TRI.

3.2 What Are the Limitations of the Emissions Data?

Methods -- Area source methods and emission factors necessarily simplify processes and emissions. When national-level emissions are calculated, the methods and factors cannot take into account local variations or use locally available activity data. Emissions using national-level methods calculate average emissions, not true local emissions. Emission factors may not reflect materials used or controls in place within a particular locality.

Facility double counting -- As discussed previously, double counting of emissions can occur when data are compiled from more than one set of data sources. To minimize double counting of emissions, all facilities whose data were used in compiling the area source inventory were examined for possible duplicate listing in the major source NTI. If a matching facility was identified in the major source inventory (using a combination of criteria such as facility name, state and county, zip code, SIC code, and TRI ID where available), that facility was not included in the area source NTI.

Double counting can also occur when facility-specific data overlaps with area source categories that have emissions estimated using top-down methods. Instances of this type of double counting include the area source NTI source categories of POTWs, landfills, and autobody refinishing, and facility emissions for SIC codes 4952, 4953, and 7532 (Electric, Gas, and Sanitary Services: Sewerage Systems; Electric, Gas, and Sanitary Services: Refuse Systems; and Automotive Repair, Services and Parking: Top and Body Repair and Paint Shops).

Spatial allocation -- A national-level inventory consists of emissions typically calculated for the entire United States, using national activity factors, national average emission factors, and considering only national regulations. It does not take into account emission reductions due to state and local regulations. National-level emissions in the area source NTI were allocated to the county level using allocation factors. An allocation factor was identified for each source category, with typical allocation factors being county-level population or employment within a certain industry. Emissions attributed to a specific facility were assigned only to the county where the facility was located. A detailed discussion of the spatial allocation procedure appears in Appendix D. An inventory prepared by a state or local agency using county-specific data can include more local detail and assign emissions to the county level more accurately.

3.3 Why Do the TRI-Derived Data in the Area Source NTI Differ From Published 1996 TRI Data?

As discussed previously, the TRI data included in the area source NTI have gone through several processing steps. Because of these processing steps the TRI data are no longer identical to the publicly available TRI data. The processing steps for the TRI data in the 1996 area source NTI consisted of:

- Selection of TRI facilities that report emissions below the CAA major/area threshold;
- Identification and removal of facilities already included in the major source NTI;
- Comparison with ESD-provided data; and
- Removal of those that overlap as either area source emitters or as major source emitters.

4.0 REFERENCES

Emission Inventory Improvement Program (EIIP). 1999a. Chapter 1: EIIP Phase I Data Model. In: *EIIP Volume VII: Data Management Procedures*. EPA-454/R-97-004g. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. Available at: <http://www.epa.gov/ttn/chief/eiip/techrep.htm#mobsrc>.

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Appendix A

Emission Estimation Methodology

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Methodology:**Summary of Emission Estimation Method for Animal Cremation**

The 1990 national emission estimates for arsenic, beryllium, cadmium, chromium, formaldehyde, nickel, and POM (as 7 and 16 PAH) were developed by multiplying an emission factor by a national activity estimate. Emission factors for these hazardous air pollutants, except formaldehyde, were taken from the State of California Air Resources Board Test Report No. C-90-004 (Reference 1). The emission factor used for formaldehyde was reported in the USEPA FIRE System Database (Reference 2). Emission factors were converted to a pound per ton basis using the procedure provided by the Emission Standards Division (Reference 3). National activity was provided by the Emission Standards Division (Reference 3) based on information reported in the 112(c)6 report (Reference 4).

The 1996 emission estimates were developed by scaling up the 1990 national activity level. It was assumed that animal mortality and cremation rates (cremations/deaths) are constant, and that the animal population is directly proportional to human population. United States population data was obtained from the U.S. Bureau of Census (Reference 5).

References:

1. State of California Air Resources Board, Engineering Evaluation Branch, Monitoring and Laboratory Division. "Evaluation Test on Two Propane Fired Crematories at Camellia Lawn Cemetery." Test Report No. C-90-004. October 29, 1992.
2. U.S. Environmental Protection Agency. Factor Information Retrieval (FIRE) System Database, Version 5.1a. Research Triangle Park, North Carolina. September 1995.
3. Crume, Richard, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Animal Cremation information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. October 30, 1998.
4. U.S. Environmental Protection Agency. *1990 Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD)/ 2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report.* Research Triangle Park, North Carolina. June 1997.
5. U.S. Bureau of Census. Monthly Estimates of the United States Population: April 1, 1980 to November 1, 1998. As found on the Census Bureau website:
www.census.gov/population/estimates/nation/intfile1-1.txt.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Animal Cremation

Methodology:

Nationwide Emissions from Animal Cremation, 1996				
Pollutant	Emission Factor (lb/ton cremated)	Emission Factor Reference	National Activity Level (Reference 1, 2, 5) (tons cremated/year)	National Emissions (tons/year)
arsenic	4.00E-04	Reference 2, 3	8.50E+04	1.70E-02
beryllium	1.84E-05	Reference 2, 3	8.50E+04	7.82E-04
cadmium	1.48E-04	Reference 2, 3	8.50E+04	6.29E-03
chromium	3.99E-04	Reference 2, 3	8.50E+04	1.70E-02
formaldehyde	2.89E-09	Reference 2, 4	8.50E+04	1.23E-07
nickel	5.09E-04	Reference 2, 3	8.50E+04	2.17E-02
POM as 7-PAH	1.03E-09	Reference 1	8.50E+04	4.38E-08
POM as 16-PAH	9.63E-04	Reference 2, 3	8.50E+04	4.09E-02
References:				
1. U.S. Environmental Protection Agency. 1990 Inventory of Section 112(c)6 Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report. Research Triangle Park, North Carolina. June 1997.				
2. Crume, Richard, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Human Cremation information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. October 30, 1998.				
3. State of California Air Resources Board, Engineering Evaluation Branch, Monitoring and Laboratory Division. "Evaluation Test on Two Propane Fired Crematories at Camellia Lawn Cemetery." Test Report No. C-90-004. October 29, 1992.				
4. U.S. Environmental Protection Agency. Factor Information Retrieval (FIRE) System Database, Version 5.1a. Research Triangle Park, North Carolina. September 1995.				
5. U.S. Bureau of Census. Monthly Estimates of the United States Population: April 1, 1980 to November 1, 1998. As found on the Census Bureau website: www.census.gov/population/estimates/nation/intfile1-1.txt.				
N/A = Not Available				
National Activity Level Calculation:				
Assumes that animal mortality and cremation rates (cremations/deaths) are constant and that the animal population is directly proportional to human population.				
Human Population 1996 / Human Population 1990 = Animal Cremations 1996 / Animal Cremations 1990				
1990 U.S. Population (July 1) =				249440000
1996 U.S. Population (July 1) =				265179000
1990 U.S. Animal cremation national activity level, tons/yr =				8.00E+04
1996 U.S. Animal cremation national activity level, tons/yr =				8.50E+04

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Asphalt Paving: Cutback Asphalt

Methodology:

Asphalt Paving: Cutback Asphalt						
National consumption of asphalt in U.S. ⁴ =			3.13E+07	short tons		
Percentage of asphalt consumed that was cutback asphalt ³ =			3.00	%		
Percentage of diluent contained in cutback asphalt (same as MC) ² =			35	%		
Density of diluent ² =			0.8	kg/L		
Density of asphalt cement ² =			1.1	kg/L		
Activity level for 1996 national consumption of cutback asphalt = National U.S. consumption * cutback asphalt %						
Activity level for 1996 national consumption of cutback asphalt =			3.13E+07	short tons	*	3.00 %
Activity level for 1996 national consumption of cutback asphalt =			9.39E+05	short tons =	8.52E+08	liter
From AP-42,						
Equation 1 ² : Amount of cutback asphalt = ("x" liter, diluent)*(density of diluent) + ("y" liter, asphalt)*(density of asphalt cement)						
Equation 2 ² : "x" liter diluent = (% of diluent contained in cutback asphalt)*("x" liter, diluent + "y" liter, asphalt cement)						
Equation 1:	8.52E+08	liter =	0.8	"x" liter, diluent +	1.1	"y" liter, asphalt
Equation 2:	"x" liter, diluent =	0.35	*("x" liter, diluent + "y" liter, asphalt cement)			
	"x" liter, diluent =	0.35	"x" liter, diluent + 0.35 "y" liter, asphalt cement			
	0.65 "x" liter, diluent =	0.35	"y" liter, asphalt cement			
Solving for "x" liter, diluent yields:						
	"x" liter, diluent =	0.538462	"y" liter, asphalt cement			
Substituting Equation 2 into Equation 1 yields:						
	8.52E+08	liter =	(0.8)*("x" liter, diluent + (1.1)*("y" liter, asphalt))			
	8.52E+08	liter =	(0.8)*(0.5385y) + (1.1)*("y" liter, asphalt)			
Solving for "y" liter asphalt cement yields:						
	"y" liter, asphalt cement	=	5.56E+08			
Entering "y" liter, asphalt cement into Equation 1 yields:						
	8.52E+08	liter	0.8	"x" liter, diluent +	1.1	* (5.56E+08)
	"x" liter, diluent =	3.00E+08	liter =	2.40E+08	kg	
Assuming that the amount of VOCs in the diluent is 70% ² , then the amount of VOCs can be calculated as follows:						
	Amount of VOCs in the diluent = (% of diluent which contains VOCs)*("x" liter, diluent)					
	Amount of VOCs in the diluent =	70	%	*	2.40E+08	kg
	Amount of VOCs in the diluent =	1.68E+08	kg			
Assume the following speciation profile ⁵ :						
	HAP	% w t of VOC				
	Ethylbenzene	2.3				
	Toluene	6.4				
	Xylene (mixed isomers)	12.2				
	Kerosene (diluent in MC) ²	79.1				
Therefore, the individual HAP estimate = Amount of VOC in diluent * % w t of individual HAP in total VOC						
	HAP	Estimate (kg)	Estimate (tpy)			
	Ethylbenzene	3.86E+06	1.93E+03			
	Toluene	1.07E+07	5.37E+03			
	Xylene (mixed isomers)	2.05E+07	1.02E+04			
Note: References 2-5 can be found on the previous page						

Methodology:

Autobody Refinishing

Individual HAP emission estimates for autobody refinishing paint application operations were calculated using VOC speciation data from the Chicago area air toxics emission inventory (Reference 1) and applying these factors to a 1995 national VOC estimate (Reference 2). National estimates of emissions of individual VOCs from autobody refinishing operations were estimated by multiplying VOC speciation data used in the Chicago area air toxics emission inventory by the 1995 baseline emissions estimated by the EPA (Reference 1).

The proposed rule for national VOC emission standards for autobody refinishing operations estimates 1995 baseline VOC emissions of 88,500 Mg/yr (97,550 tons/year). Although the proposed rule also estimates 1996 emissions to be reduced by 32,500 Mg (35,800 tons) (Reference 2), actual facility emission reductions may not occur until after the September 1998 compliance date (Reference 3). Therefore, the 1995 baseline estimates are assumed to be more representative of 1996 emissions.

VOC Speciation Factors:	Ethylbenzene	0.5%, by weight
	Methyl Ethyl Ketone	0.5%, by weight
	Methyl Isobutyl Ketone	0.3%, by weight
	Toluene	37.8%, by weight
	Xylene	8.1%, by weight

Emissions of lead from autobody refinishing in 1996 were estimated by dividing the 1989 national estimate of lead from paint application in large, medium, and small shops (Reference 4) by 1989 population and then multiplying this by the 1996 population (Reference 5).

Emissions of all estimated compounds were allocated to state and county levels based on 1996 population data.

References:

1. Radian Corporation. *Development of Area Source Hazardous Air Pollutant Inventories, Volume 1: Air Toxic Emission Inventory for the Chicago Area, Draft Report*. Prepared for U.S. EPA, Air & Energy Engineering Research Laboratory. Research Triangle Park, North Carolina. July 1995. pp. 3-36, and 3-37.
2. *Federal Register*, 61 FR 19055. National Volatile Organic Compound Emission Standards for Automobile Refinish Coatings. Proposed Rule and Notice of Public Hearing. April 30, 1996.
3. *Federal Register*, 63 FR 48806. National Volatile Organic Compound Emission Standards for Automobile Refinish Coatings. Final Rule. September 11, 1998.
4. U.S. Environmental Protection Agency. *Locating & Estimating Air Emissions from Sources of Lead and Lead Compounds, Draft Report*. Research Triangle Park, North Carolina. July 1996. p. B-51.
5. U.S. Bureau of the Census. *Estimates of the Population of Counties: Annual Time Series, July 1, 1990 to July 1, 1997* (includes revised April 1, 1990 census population counts). (CO-97-4) Source: Population Estimates Program, Population Division. Washington, D.C.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Autobody Refinishing Paint Application

Methodology:

Autobody Refinishing Paint Application							
<i>VOC Emissions Calculations</i>							
VOC Speciation Factors (Reference 1):							
Ethylbenzene		0.5%, by weight					
Methyl Ethyl Ketone (MEK)		0.5%, by weight					
Methyl Isobutyl Ketone (MIBK)		0.3%, by weight					
Toluene		37.8%, by weight					
Xylene		8.1%, by weight					
National Estimate (Reference 2) = 97,550 tons VOC / year							
Speciated VOCs = (VOC emitted) x (HAP %, by weight / 100)							
Ethylbenzene = (97,550 tons/yr) x 0.005 =				487.75	tons Ethylbenzene / year		
Methyl Ethyl Ketone = (97,550 tons/yr) x 0.005 =				487.75	tons MEK / year		
Methyl Isobutyl Ketone = (97,550 tons/yr) x 0.003 =				292.65	tons MIBK / year		
Toluene = (97,550 tons/yr) x 0.378 =				36,873.90	tons Toluene / year		
Xylene = (97,550 tons/yr) x 0.081 =				7,901.55	tons Xylene / year		

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Autobody Refinishing Paint Application

Methodology:

Autobody Refinishing Paint Application									
<i>Lead Emissions Calculations</i>									
1989 estimates from Lead L&E (Reference 4)									
Emissions from small shops = 69,933 lb lead / 2,000 lb/ton = 34.967 tons lead from small shops									
Emissions from medium shops = 11,666 lb lead / 2,000 lb/ton = 5.833 tons lead from medium shops									
Emissions from large shops = 8,166 lb lead / 2,000 lb/ton = 4.083 tons lead from large shops									
1989 Emissions from all size shops = 44.883 tons lead / year									
1996 Emissions from all size shops = (1989 emissions / 1989 population) x 1996 population (Reference 5)									
1996 Emissions from all size shops = (44.883 tons / 246819230) x 265179411									
1996 Emissions from all size shops = 48.22 tons lead / year from autobody refinishing									

Methodology:**Aviation Gasoline Distribution: Stage I & II**

The 1990 emissions of lead from aviation gasoline distribution were reported as 0.15 tons (Reference 1). This estimate was based on information reported in the Locating and Estimating Lead report (Reference 2), which reported an annual fuel throughput of 8910 thousand barrels of aviation gasoline. The Energy Information Administration reported annual aviation gasoline sales of 6860 thousand barrels (Reference 3). Lead emissions from aviation gasoline sales in 1996 were estimated by reducing the 1990 lead emissions by the ratio of 1996 throughput to 1990 throughput.

Example calculation:

$$(0.15 \text{ tons lead, 1990}) * \frac{6860 \text{ thousand barrels, 1996}}{8910 \text{ thousand barrels, 1990}} = 0.12 \text{ tons lead, 1996}$$

References:

1. U.S. Environmental Protection Agency. *1990 Emissions Inventory of Forty Section 112(k) Pollutants, Supporting Data for EPA's Proposed Section 112(k) Regulatory Strategy, Interim Final Report*. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. January 1998.
2. U.S. Environmental Protection Agency. *Locating and Estimating Air Emissions for Sources of Lead. Draft Report* (EPA-454/R-98-006). Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. May 1998.
3. Energy Information Administration. *Petroleum Marketing Annual, 1996*. U.S. Department of Energy, Washington, D.C. October 1997.

Methodology:

Summary of Emission Estimation Method for Consumer Products Usage

The 1996 emission estimates for consumer products usage were calculated for 36 hazardous air pollutants (HAPs) by multiplying an emission factor by an activity factor. The emission factors were provided for the following subcategories of consumer products: personal care products, household products, automotive aftermarket products, adhesives and sealants, FIFRA-regulated products, coatings and related products, and miscellaneous (Reference 1). These emission factors were multiplied by a 1996 national population of 265,179,411 (Reference 2). Emissions of each HAP from consumer product usage were reported as the sum of the emissions from each of the six subcategories.

References:

1. Emission Inventory Improvement Program. August 1996. Chapter 5: Consumer and Commercial Solvent Use. In: *EIIP Volume III, Area Sources Preferred and Alternative Methods*. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, EPA-454/R-97-004c. Research Triangle Park, North Carolina. July 1997.
2. U.S. Bureau of the Census, Population Division. *Population Estimates Program*. Washington, D.C. March 1998.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Consumer Products Usage

Methodology:

National Emissions From Consumer Products Usage								
Pollutant	Per Capita Emission Factor (lb/year/person)							1996 Emissions (tons) ^a
	Personal Care Products	Household Products	Automotive Aftermarket Products	Adhesives & Sealants	FIFRA-Regulated Products	Coatings & Related Products	Misc.	
Acetamide	1.38E-07							1.83E-02
Acetophenone						8.53E-06		1.13E+00
Acrylic acid				3.94E-09				5.22E-04
Benzene			4.72E-06					6.26E-01
Carbon tetrachloride						4.10E-10		5.44E-05
Chlorobenzene					7.16E-02	1.51E-05		9.50E+03
Chloroform			3.60E-05			9.55E-04		1.31E+02
Dibenzofurans				8.07E-06				1.07E+00
1,2-Dichloroethane	4.62E-06	3.52E-08						6.17E-01
1,4-Dichlorobenzene		4.79E-02			3.52E-02			1.10E+04
1,3-Dichloropropene					1.60E-01			2.12E+04
Dimethylformamide	2.71E-05		2.78E-08	2.29E-07			7.43E-06	4.61E+00
1,4-Dioxane				1.09E-05				1.45E+00
Ethylbenzene		2.56E-06	7.51E-05	1.36E-05	1.30E-03	6.86E-04		2.75E+02
Ethylene oxide					1.51E-02			2.00E+03
Formaldehyde		6.74E-06		2.51E-05	3.81E-04	8.55E-04		1.68E+02
Glycol ethers	1.52E-05	5.31E-03	2.69E-02	1.28E-04	5.65E-03	2.24E-03	2.42E-04	5.37E+03
Hexane		2.09E-03	3.53E-03	7.83E-02		2.39E-03		1.14E+04
Hydrochloric acid		1.75E-06						2.32E-01
Hydrogen fluoride		8.75E-08	1.41E-05					1.88E+00
Isophorone					9.47E-04			1.26E+02
Methanol	5.67E-07	6.66E-04	6.61E-01	6.82E-04	9.48E-04	1.60E-02	1.84E-02	9.25E+04
Methyl bromide					2.22E-01			2.94E+04
Methyl ethyl ketone	1.75E-05	4.49E-04	3.04E-03	3.91E-02	2.01E-05	7.94E-03	1.01E-05	6.71E+03
Methyl isobutyl ketone		1.08E-04	8.73E-04	1.24E-03	9.01E-05	5.26E-03		1.00E+03
Methyl tert-butyl ether			2.36E-05					3.13E+00
Methylene chloride		2.39E-03	4.83E-03	8.78E-03	6.81E-04	1.97E-02	2.38E-05	4.83E+03
Napthalene		5.52E-07	2.26E-06	1.07E-04	4.60E-02	5.75E-06		6.11E+03
2-Nitropropane				2.12E-06				2.81E-01
Perchloroethylene		2.96E-03	2.35E-02	6.75E-04	1.92E-04	1.48E-04	7.53E-04	3.74E+03
Toluene	3.41E-03	5.82E-04	2.49E-02	8.43E-02		3.16E-01	2.46E-06	5.69E+04
1,1,1-Trichloroethane	7.45E-04	2.85E-02	7.63E-02	2.14E-01	5.99E-02	7.69E-03	2.46E-04	5.14E+04
Trichloroethylene		4.34E-05	2.67E-04	3.88E-05		1.37E-04		6.45E+01
Triethylamine					3.13E-04	5.26E-04		1.11E+02
Vinyl acetate				4.94E-08				6.55E-03
Xylenes		3.28E-03	1.20E-02	9.76E-03	1.37E-01	4.05E-02	4.31E-04	2.69E+04
^a Emissions are based on a 1996 population of 265,179,411 (Source: Population Estimates Program, Population Division, U.S. Bureau of the Census, Washington, DC 20233.).								
Note: Total 1996 emissions from the consumer products category are calculated as the sum of each of the 7 emission factors presented in this table, multiplied by the 1996 national population.								

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Dental Preparation and Use

Methodology:

Summary of Emission Estimation Method for Dental Preparation and Use

National level emissions of mercury from dental preparations and use are taken from the *1990 Inventory of Section 112 (c)(6) Pollutants* (Reference 1).

The estimates are representative of 1990 emissions.

This category is entirely an area source. Apportionment of the emissions are based on the 1996 state and county employment in SIC Industry Code 8072, for Dental Laboratories.

References:

1) U.S. Environmental Protection Agency. *1990 Emissions Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report.* Research Triangle Park, North Carolina. April 1998.

Methodology:

Summary of Emission Estimation Method for Drum and Barrel Reclamation

National level emissions of dioxins/furans and polycyclic organic matter from drum and barrel reclamation are taken from the *1990 Inventory of Section 112 (c)(6) Pollutants* (Reference 1). Estimates of lead emissions are taken from *Locating and Estimating Air Emissions from Sources of Lead and Lead Compounds* (Reference 2).

The lead estimates are representative of 1994 emissions; the estimates for the other hazardous air pollutants are for 1990.

References:

- 1) U.S. Environmental Protection Agency. *1990 Emissions Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report.* Research Triangle Park, North Carolina. April 1998.
- 2) U.S. Environmental Protection Agency. *Locating and Estimating Air Emissions from Sources of Lead and Lead Compounds. Final Report.* EPA-454/R-98-006. Research Triangle Park, North Carolina. May 1998.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Fluorescent Lamp Recycling

Methodology:

Summary of Emission Estimation Method for Fluorescent Lamp Recycling

National level emissions of mercury from fluorescent lamp recycling are taken from the *1990 Inventory of Section 112 (c)(6) Pollutants* (Reference 1). The estimates are representative of 1990 emissions.

The estimate reported here is the area source contribution as reported in Reference 1. Apportionment of the emissions to the county level are based on the 1996 population data.

References:

1) U.S. Environmental Protection Agency. *1990 Emissions Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report.* Research Triangle Park, North Carolina. April 1998.

Methodology:

Food and Agricultural Products: Cotton Ginning

Cotton ginning is the process of harvesting cotton to produce cotton lint.

National estimates of arsenic emissions from cotton ginning were estimated using emission factors provided by the EPA in the Factor Information Retrieval (FIRE) System Database (Reference 1).

Activity data for 1994 and 1995 were identified in the EPA's emission factor document, AP-42. (Reference 2).

It is assumed that the activity for this category remains constant from year to year and that the emissions estimated using 1994/1995 activity are representative of 1996 cotton ginning activities.

References:

1. U.S. Environmental Protection Agency. Factor Information Retrieval (FIRE) System Database, Version 5.1a. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. September 1995.
2. U.S. Environmental Protection Agency. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point Area Sources, Fifth Edition, AP-42. Section 9.7: Cotton Ginning.* Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. June 1996.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Food and Agricultural Products: Cotton Ginning

Methodology:

NATIONAL EMISSIONS ESTIMATE				
SOURCE CATEGORY:	Cotton Ginning			
ESTIMATION METHOD:	Activity level (bales produced) times conversion factor (ton/bale) times emission factor (lb/ton produced)			
ESTIMATE:				
Activity Levels				
		Notes		
Bales ginned cotton produced, 1994/1995	19,122,000	(1)		
Tons ginned cotton/bale of ginned cotton	0.24	(1)		
Tons ginned cotton produced, 1994/1995	4,589,280	(2)		
Percent cotton harvest machine-picked	75%	(1), (3)		
Tons ginned cotton produced from machine-picked cotton.	3,441,960	(4)		
Percent cotton harvest machine-stripped	25%	(1)		
Tons ginned cotton produced from machine-stripped cotton.	1,147,320	(5)		
Notes:				
(1) U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, 5th Edition. Section 9.7 Cotton Ginning. June 1996.				
(2) Bales produced * ton/bale				
(3) Median of range provided in reference: 70% - 80%				
(4) Percent of harvest that is machine picked * total harvest (tons)				
(5) Percent of harvest that is machine stripped * total harvest (tons)				
Emission Factors				
Pollutant	Process/Operation	Factor	Units	Notes:
Arsenic	Machine-picked	6.00E-04	lb/ton produced	(6)
Arsenic	Machine-stripped	1.74E-02	lb/ton produced	(6), (7)
Notes:				
(6) U.S. Environmental Protection Agency. Factor Information Retrieval (FIRE) System Database, Version 5.1a. Research Triangle Park, North Carolina. September, 1995.				
(7) Median of range provided in reference: 8.00E-04 - 3.40E-02.				
Calculations				
		Notes		
Arsenic emissions from machine-picked cotton, tons	1.03	(8)		
Arsenic emissions from machine-stripped cotton, tons	9.98	(8)		
Total Arsenic Emissions, tons/yr	11.01			
Notes:				
(8) lb pollutant emitted/ton cotton produced * ton/2000 lb * tons cotton produced				

Methodology:

Gasoline Distribution Stage II

The 1996 sales of fuel for baseline, reformulated, and winter-oxygenated gasolines were obtained from the Energy Information Administration (Reference 1). Reformulated gasoline was further divided into reformulated gasoline with methyl tertiary butyl ether (MTBE) and reformulated gasoline with ethanol, by market share (81% and 19%, respectively) (Reference 2). Likewise, 18% of winter-oxygenated gasoline sales were apportioned as winter-oxygenated fuel with MTBE and 82% with ethanol. These sales figures were multiplied by a VOC emission factor of 1,340 mg VOC/L of gasoline (Reference 3), yielding annual VOC emission estimates for each gasoline type. The VOC estimates were then speciated by hazardous air pollutant (HAP), based on the following source fingerprints:

Table 1: Percent of VOC Emissions

Pollutant	Gasoline Type				
	Baseline	Reformulated		Winter-Oxygenated	
		w/ MTBE	w/ Ethanol	w/ MTBE	w/ Ethanol
2,2,4-Trimethylpentane	0.8	0.7	0.7	0.7	0.7
Benzene	0.9	0.4	0.4	0.7	0.7
Ethylbenzene	0.1	0.1	0.1	0.1	0.1
Hexane	1.6	1.4	1.4	1.4	1.4
MTBE	0	8.7	0	11.9	0
POM as 16-PAH	0.05	0.05	0.05	0.05	0.05
Toluene	1.3	1.1	1.1	1.1	1.1
Xylene	0.5	0.4	0.4	0.4	0.4

Note: Emission factors, except for POM as 16-PAH, are as reported in Background Information Document for the gasoline distribution industry (Reference 4). The emission factor for POM as 16-PAH was consistent with the 1990 Inventory of Section 112(c)(6) Pollutants (Reference 5).

References:

1. Energy Information Administration, U.S. Department of Energy. October 1997. *Petroleum Marketing Annual, 1996*. Washington, D.C.
2. Memorandum from Rich Cook, U.S. EPA/OMS, to Laurel Driver and Anne Pope, U.S. EPA/OAQPS. "Guidance on Mobile Source Emission Estimates in the 1996 National Toxics Inventory." June 9, 1998.
3. U.S. Environmental Protection Agency. *Technical Guidance - Stage II Vapor Recovery Systems for Control of Vehicle Refueling Emissions at Gasoline Dispensing Facilities, Volume 1* (EPA-450/3-919-022a), Office of Air Quality Planning and Standards, November 1991.
4. U.S. Environmental Protection Agency. Gasoline Distribution Industry (Stage 1) - Background Information for Proposed Standards (EPA-453/R-94-002a). Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. January 1994.
5. U.S. Environmental Protection Agency. *1990 Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD), 2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report*. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. June 1997.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Gasoline Distribution Stage II

Methodology:

Gasoline Distribution Stage II

Parameter	Baseline Gasoline	Reformulated Gasoline		Winter Oxygenated Gasoline		Total
		w/MTBE	w/o MTBE	w/MTBE	w/o MTBE	
1996 Gasoline Sales (millions of gallons)	13,306	5,218	1,224	226	1,028	21,001
1996 VOC Emissions (tons)	74,397	29,173	6,843	1,262	5,748	117,424

1996 HAP Emissions (tons)

Pollutant	Baseline Gasoline	Reformulated Gasoline		Winter Oxygenated Gasoline		Total
		w/MTBE	w/o MTBE	w/MTBE	w/o MTBE	
2,2,4-Trimethylpentane	595.18	204.21	47.90	8.83	40.24	896.36
Benzene	669.57	116.69	27.37	8.83	40.24	862.71
Ethylbenzene	74.40	29.17	6.84	1.26	5.75	117.42
Hexane	1190.35	408.43	95.80	17.67	80.47	1792.72
MTBE	0.00	2538.08	0.00	150.15	0.00	2688.23
POM as 16-PAH	37.20	14.59	3.42	0.63	2.87	58.71
Toluene	967.16	320.91	75.27	13.88	63.23	1440.45
Xylene	371.99	116.69	27.37	5.05	22.99	544.09

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - General Laboratory Activities

Methodology:

Summary of Emission Estimation Method for General Laboratory Activities

National level emissions of mercury from general laboratory activities are taken from the *1990 Inventory of Section 112 (c)(6) Pollutants* (Reference 1). The estimates are representative of 1990 emissions.

The estimate reported here is the area source contribution as reported in Reference 1. Apportionment of the emissions to the county level are based on the 1996 population data.

References:

1) U.S. Environmental Protection Agency. *1990 Emissions Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report.* Research Triangle Park, North Carolina. April 1998.

Methodology:

Geothermal Power

Geothermal power is power generated from the extraction of steam produced by underground natural sources and the recovery of heat from the steam for various purposes such as to drive a steam turbine.

An estimate of 1.4 tons of mercury emissions per year from geothermal power generation was identified in the *Mercury Report to Congress* (Reference 1). The estimate in the report was made by multiplying emission factors times the net capacity of geothermal power plants that were in operation in 1992. The emission factors used in the report to Congress were developed in 1977 to estimate emissions from uncontrolled sources and have a high degree of uncertainty.

It is assumed for this inventory that facility capacities for geothermal power production remain approximately consistent from year to year and the estimate of emissions in 1992 is not significantly different than they would be in 1996. However, the emission factors used for the 1992 estimates may not be representative of industry characteristics in 1996.

Reference:

1. U.S. Environmental Protection Agency. *Mercury Report to Congress, Volume I: Executive Summary*. Office of Air Quality Planning and Standards and the Office of Research and Development. December 1997. Pp. 4-74 through 4-77.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Geothermal Power

Methodology:

NATIONAL EMISSIONS ESTIMATE					
SOURCE CATEGORY:	Geothermal Pow er				
ESTIMATION METHOD:	A 1994/1995 estimate reported in an EPA document is used for this source category.				
ESTIMATE:	Pollutant	Estimate			
	Mercury	1.4 ton/yr			
	Note: Mercury is the only pollutant for which an estimate, or data to develop an estimate, has been identified.				
Reference:					
U.S. Environmental Protection Agency. Mercury Report to Congress, Volume I: Executive Summary. Office of Air Quality Planning and Standards and the Office of Research and Development. December 1997.					

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Hospital Sterilizers

Methodology:

Hospital Sterilizers

National estimates of emissions of ethylene oxide (EO) from hospital sterilization were estimated using emission factors provided by the EPA for large, medium, and small hospitals (Reference 1). The referenced emission factors are based on the number of hospital beds, by size of hospital, in 1988. Ethylene oxide use in 1988 was estimated by mathematically converting Freon use to ethylene oxide use.

The American Hospital Association provided data on the number of hospital beds in large, medium, and small hospitals in 1996 (Reference 2).

Emission Factors:

1.05 kg EO/yr/bed for large hospitals w/ >500 beds.
0.63 kg EO/yr/bed for medium hospitals w/ 200 - 500 beds.
0.82 Kg EO/yr/bed for small hospitals w/ <200 beds.

<u>Number of hospitals, 1996</u>	<u>Size</u>	<u>Number of Beds</u>
354	Large	251,806
1,444	Medium	440,757
4,403	Small	369,123

Calculations

(0.82 kg EO/yr/bed) x (369123 beds, small hospitals) = 302,681 kg EO
(0.63 kg EO/yr/bed) x (440757 beds, medium hospitals) = 277,677 kg EO
(1.05 kg EO/yr/bed) x (251806 beds, large hospitals) = 264,396 kg EO

302,681 kg + 277,677 kg + 264,396 kg = 844,754 kg x (0.0011023 kg/Ton) = 931.172 tons EO

References:

1. Dave Markwordt, U.S. Environmental Protection Agency. Memorandum: Hospital Sterilization Nationwide Emission Estimates. March 16, 1989.
2. American Hospital Association. *1998 Hospital Statistics*. Fax date: 12/4/98. Pg. 4 (The 1998 document contains 1996 summary data).

Methodology:

Summary of Emission Estimation Method for Human Cremation

The 1996 national emission estimates for arsenic, beryllium, cadmium, chromium, formaldehyde, mercury, nickel, POM as 7-PAH and POM as 16-PAH were developed by multiplying an emission factor by a national activity estimate. Emission factors for these hazardous air pollutants except formaldehyde were taken from the State of California Air Resources Board Test Report No. C-90-004 (Reference 1). The emission factor used for formaldehyde was reported in the USEPA FIRE System Database (Reference 2). Emission factors were converted to a pound-per-ton basis using the procedure provided by the Emission Standards Division (Reference 3). National activity was provided by the Emission Standards Division (Reference 3) based on an assumed body weight of 150 pounds and information reported by the Cremation Association of North America (Reference 4) that 21.13 percent of bodies were cremated and that there were 2,322,265 deaths in the United States in 1996 (Reference 5).

References:

1. State of California Air Resources Board, Engineering Evaluation Branch, Monitoring and Laboratory Division. "Evaluation Test on Two Propane Fired Crematories at Camellia Lawn Cemetery." Test Report No. C-90-004. October 29, 1992.
2. U.S. Environmental Protection Agency. Factor Information Retrieval (FIRE) System Database, Version 5.1a. Research Triangle Park, North Carolina. September 1995.
3. Crume, Richard, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Human and Animal Cremation information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. October 30, 1998.
4. Cremation Association of North America. 1996 statistics as found on the Internet Cremation Society, Cremation Stats Nationwide webpage: www.cremation.org/stats.htm.
5. Ventura, S. et al. "Births and Deaths: United States, 1996." *Monthly Vital Statistics Report*, Vol. 64, No. 1, Supplement 2. September 11, 1997. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health and Statistics.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Human Cremation

Methodology:

Nationwide Emissions from Human Cremation, 1996				
Pollutant	Emission Factor (lb/ton cremated)	Emission Factor Reference	National Activity Level (References 1, 2, 5) (tons cremated/year)	National Emissions (tons/year)
arsenic	4.00E-04	Reference 2, 3	3.68E+04	7.36E-03
beryllium	1.84E-05	Reference 2, 3	3.68E+04	3.39E-04
cadmium	1.48E-04	Reference 2, 3	3.68E+04	2.72E-03
chromium	3.99E-04	Reference 2, 3	3.68E+04	7.34E-03
formaldehyde	2.89E-09	Reference 2, 4	3.68E+04	5.32E-08
mercury	4.39E-02	Reference 2, 3	3.68E+04	8.07E-01
nickel	5.09E-04	Reference 2, 3	3.68E+04	9.37E-03
POM as 7-PAH	1.03E-09	Reference 2, 3	3.68E+04	1.90E-08
POM as 16-PAH	9.63E-04	Reference 2, 3	3.68E+04	1.77E-02

References:

1. Cremation Association of North America. 1996 statistics as found on the Internet Cremation Society, Cremation Stats Nationw ide w ebpage: w w w .cremation.org/stats.htm.
2. Crume, Richard, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Human and Animal Cremation information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. October 30, 1998.
3. State of California Air Resources Board, Engineering Evaluation Branch, Monitoring and Laboratory Division. "Evaluation Test on Tw o Propane Fired Crematories at Camellia Law n Cemetery." Test Report No. C-90-004. October 29, 1992.
4. U.S. Environmental Protection Agency. Factor Information Retrieval (FIRE) System Database, Version 5.1a. Research Triangle Park, North Carolina. September 1995.
5. Ventura, S. et al. "Births and Deaths: United States, 1996." *Monthly Vital Statistics Report*, Vol. 64, No. 1, Supplement 2. September 11, 1997. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

Activity Level Calculation:			
Assume each body w eighs 150 lb			
1996 Deaths in the U.S. =		2,322,265	
1996 percentage of bodies cremated in the U.S. =		21.13	
1996 Activity, tons/yr=	1996 deaths x fraction cremated x body w eight x ton/2000lb		
1996 Activity, tons/yr=		3.68E+04	

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Lamp Breakage

Methodology:

Summary of Emission Estimation Method for Lamp Breakage

National level emissions of mercury from lamp breakage are taken from the *1990 Inventory of Section 112 (c)(6) Pollutants* (Reference 1). The estimates are representative of 1990 emissions.

The estimate reported here is the area source contribution as reported in Reference 1. Apportionment of the emissions to the county level are based on the 1996 population data.

References:

1) U.S. Environmental Protection Agency. *1990 Emissions Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report.* Research Triangle Park, North Carolina. April 1998.

Methodology:

Summary of Emission Estimation Method for Miscellaneous Organic Chemical Processes

National estimates of emissions from miscellaneous organic chemical processes are taken from the *1990 Emissions Inventory of Section 112 (k) Pollutants* (Reference 1). The baseyear of these estimates in the Section 112 (k) inventory is 1995.

Approximately one percent of the emissions are attributed to area sources. Area source estimates were derived by multiplying the estimates in the Section 112 (k) inventory by one percent.

References:

1) U.S. Environmental Protection Agency. *1990 Emissions Inventory of Forty Section 112(k) Pollutants*. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. April 1999.

Methodology:

Emissions were estimated for forest fires and wildfires by multiplying pollutant emission factors by biomass consumed in the fires. The 1996 base year estimates for biomass consumed were obtained from the National Interagency Fire Center (NIFC).¹ The NIFC collects national estimates of acreage burned as a result of forest and wildfires. The estimates are provided for the following types of land ownership: 1) Bureau of Indian Affairs (BIA); 2) Bureau of Land Management (BLM); 3) Fish and Wildlife Service (FWS); 4) National Park Service (NPS); 5) States who submit data; and 6) United States Forest Service (USFS). Absent from the NIFC estimates would be any fires occurring on private lands and state lands that are not reported to the NIFC.

In order to convert from acreage burned to biomass consumed, a conversion factor of 10.4 tons/acre was used.² Emission factors for benzene, butadiene, and formaldehyde were obtained from the Section 112(k) inventory documentation.² The emission factors for acrolein, acetaldehyde, carbonyl sulfide, methyl chloride, toluene, and xylenes were obtained from Ward et al.³ The emission factor for dioxin/furans as 2,3,7,8-TCDD TEQ was obtained from the Section 112(c)(6) report.⁴ The emission factors for PAH compounds were obtained from the POM L&E report.⁵

Emissions were estimated for two types of fuel combustion conditions, flaming and smoldering. It was assumed that during forest and wildfires, 75 percent of biomass is burned under flaming conditions and 25 percent of biomass is burned under smoldering conditions. For some pollutants, emission factors were not available for both combustion conditions so the same factor was used for both combustion conditions.

References:

1. National Interagency Fire Center, Boise, Idaho. Incident Management Situation Report, Friday, December 27, 1996: Acres Burned Year to Date. Located at: <http://www.nifc.gov>.
2. U.S. Environmental Protection Agency. *National Urban Area Source Emissions of Benzene, 1,3-Butadiene, Formaldehyde, Trichloroethylene, Perchloroethylene, Methylene Chloride, and Carbon Tetrachloride. Final Report.* Research Triangle Park, North Carolina. March 1996.
3. Ward, D., Peterson, J., and Hao, W. *An Inventory of Particulate Matter and Air Toxic Emissions from Prescribed Fires in the U.S. for 1989.* U.S. Forest Service. Missoula, Montana, and the Wood Chemistry Laboratory, School of Forestry, University of Montana, Missoula, Montana. 1993.
4. U.S. Environmental Protection Agency. *1990 Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report.* Research Triangle Park, North Carolina. June 1997.
5. U.S. Environmental Protection Agency. *Locating and Estimating Air Emissions from Sources of Polycyclic Organic Matter. Final Report.* Research Triangle Park, North Carolina. EPA-454/R-98-014. July 1998. pp. 4-450 through 4-459.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Open Burning: Forest and Wildfires

Methodology:

Part 1: Calculation of Biomass consumption from acres burned, by fuel type					
Assume 1) a biomass consumption rate of 10.4 tons/acre for forest fires and wildfires, 2) 75% of biomass burned under flaming conditions, 25% under smoldering conditions.					
Area	Total	Biomass Consumed	Flaming	Smoldering	
	(acres)	(tons)	(tons)	(tons)	
Alaska	595,777.00	6,196,080.80	4,647,060.60	1,549,020.20	
Northw est	645,419.00	6,712,357.60	5,034,268.20	1,678,089.40	
CA-North	155,370.00	1,615,848.00	1,211,886.00	403,962.00	
CA-South	513,195.00	5,337,228.00	4,002,921.00	1,334,307.00	
Northern	240,962.00	2,506,004.80	1,879,503.60	626,501.20	
Great Basin-East	1,303,045.00	13,551,668.00	10,163,751.00	3,387,917.00	
Great Basin-West	604,880.00	6,290,752.00	4,718,064.00	1,572,688.00	
Southw est	341,005.00	3,546,452.00	2,659,839.00	886,613.00	
Rocky Mtn.	272,220.00	2,831,088.00	2,123,316.00	707,772.00	
Eastern	177,643.00	1,847,487.20	1,385,615.40	461,871.80	
Southern	1,212,945.00	12,614,628.00	9,460,971.00	3,153,657.00	
USA Total	6,062,461.00	63,049,594.40	47,287,195.80	15,762,398.60	
Part 2: Calculation of Emission Estimates					
HAP	Emission Factor (lb/ton)		Emission Estimate (tons / year)		Total HAP Estimate (tons / year)
	Flaming Fuel Type	Smoldering Fuel Type	Flaming Fuel Type	Smoldering Fuel Type	
1,3-butadiene	2.40E-01	9.00E-01	5674.46	7093.08	12767.54
2,3,7,8-TCDD TEQ	2.00E-09	2.00E-09	4.73E-05	1.58E-05	6.30E-05
acetaldehyde	4.73E-01	2.14E-01	11171.60	1688.15	12859.75
acrolein	4.68E-01	2.92E-01	11071.35	2299.42	13370.77
anthracene	5.00E-03	5.00E-03	118.22	39.41	157.62
benz(a)anthracene	6.20E-03	6.20E-03	146.59	48.86	195.45
benzene	6.60E-01	2.52E+00	15604.77	19860.62	35465.40
benzo(a)fluoranthene	2.60E-03	2.60E-03	61.47	20.49	81.96
benzo(a)pyrene	1.48E-03	1.48E-03	34.99	11.66	46.66
benzo(c)phenanthrene	3.90E-03	3.90E-03	92.21	30.74	122.95
benzo(e)pyrene	2.66E-03	2.66E-03	62.89	20.96	83.86
benzo(ghi)perylene	5.08E-03	5.08E-03	120.11	40.04	160.15
benzo(k)fluoranthene	2.60E-03	2.60E-03	61.47	20.49	81.96
benzofluoranthenes	5.14E-03	5.14E-03	121.53	40.51	162.04
carbonyl sulfide	5.34E-04	5.34E-04	12.63	4.21	16.83
chrysene	6.20E-03	6.20E-03	146.59	48.86	195.45
fluoranthene	6.73E-03	6.73E-03	159.03	53.01	212.04
formaldehyde	1.50E+00	5.80E+00	35465.40	45710.96	81176.35
indeno(1,2,3-cd)pyrene	3.41E-03	3.41E-03	80.62	26.87	107.50
methyl chloride	1.01E-02	4.83E-01	238.80	3806.62	4045.42
methylanthracene	8.23E-03	8.23E-03	194.59	64.86	259.45
methylbenzopyrenes	2.96E-03	2.96E-03	69.99	23.33	93.31
methylchrysene	7.90E-03	7.90E-03	186.78	62.26	249.05
methylpyrene, -fluoranthen	9.05E-03	9.05E-03	213.97	71.32	285.30
n-hexane	1.89E-02	8.91E-03	447.76	70.21	517.97
o,m,p-xylene	2.79E-01	1.31E-01	6584.74	1032.44	7617.18
perylene	8.56E-04	8.56E-04	20.24	6.75	26.99
phenanthrene	5.00E-03	5.00E-03	118.22	39.41	157.62
pyrene	9.29E-03	9.29E-03	219.65	73.22	292.87
toluene	6.55E-01	3.08E-01	15487.31	2428.29	17915.61

Methodology:

Emissions were estimated for prescribed burnings by multiplying pollutant emission factors by biomass consumed in the fires. The 1996 base year estimates for biomass consumed were obtained from the National Interagency Fire Center (NIFC).¹ The NIFC collects national estimates of acreage burned as a result of wildfires and prescribed burning. The prescribed burning estimates are provided only for following types of land ownership: 1) Bureau of Indian Affairs (BIA); 2) Bureau of Land Management (BLM); 3) Fish and Wildlife Service (FWS); 4) National Park Service (NPS); 5) States who submit data; and 6) United States Forest Service (USFS). Absent from the NIFC estimates would be any fires occurring on private lands and state lands that are not reported to the NIFC.

In order to convert from acreage burned to biomass consumed, a conversion factor of 8.2 tons/acre was used.² Emission factors for benzene, butadiene, and formaldehyde were obtained from the Section 112(k) inventory documentation.² The emission factors for acrolein, acetaldehyde, carbonyl sulfide, methyl chloride, toluene, and xylenes were obtained from Ward, et al.³ The emission factor for dioxin/furans as 2,3,7,8-TCDD TEQ was obtained from the Section 112(c)(6) report.⁴ The emission factors for PAH compounds were obtained from the POM L&E report.⁵

Emissions were estimated for two types of fuel combustion conditions, flaming and smoldering. It was assumed that during forest and wildfires, 75 percent of biomass is burned under flaming conditions and 25 percent of biomass is burned under smoldering conditions. For some pollutants, emission factors were not available for both combustion conditions so the same factor was used for both combustion conditions.

References:

1. National Interagency Fire Center, Boise, Idaho. Database of Prescribed Burning Statistics for Base Year 1996. January 1999.
2. U.S. Environmental Protection Agency. *National Urban Area Source Emissions of Benzene, 1,3-Butadiene, Formaldehyde, Trichloroethylene, Perchloroethylene, Methylene Chloride, and Carbon Tetrachloride. Final Report.* Research Triangle Park, North Carolina. March 1996.
3. Ward, D., Peterson, J., and Hao, W. *An Inventory of Particulate Matter and Air Toxic Emissions from Prescribed Fires in the U.S. for 1989.* U.S. Forest Service. Missoula, Montana, and the Wood Chemistry Laboratory, School of Forestry, University of Montana, Missoula, Montana. 1993.
4. U.S. Environmental Protection Agency. *1990 Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report.* Research Triangle Park, North Carolina. June 1997.
5. U.S. Environmental Protection Agency. *Locating and Estimating Air Emissions from Sources of Polycyclic Organic Matter. Final Report.* Research Triangle Park, North Carolina. EPA-454/R-98-014. July 1998. pp. 4-450 through 4-459.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Open Burning: Prescribed Burnings

Methodology:

Part 1: Calculation of Biomass consumption from acres burned, by fuel type

Assume 1) a biomass consumption rate of 8.2 tons/acre for prescribed burnings, 2) 75% of biomass burned under flaming conditions, 25% under smoldering conditions.

	Acres Burned	Biomass Consumed (tons)	Flaming (tons)	Smoldering (tons)
US TOTAL	3,133,686.00	25,696,225.20	19,272,168.90	6,424,056.30

Part 2: Calculation of Emission Estimates

HAP	Emission Factor (lb/ton)		Emission Estimate (tons / year)		Total HAP Estimate (tons / year)
	Flaming Fuel Type	Smoldering Fuel Type	Flaming Fuel Type	Smoldering Fuel Type	
1,3-butadiene	2.40E-01	9.00E-01	2312.66	2890.83	5203.49
2,3,7,8-TCDD TEQ	2.00E-09	2.00E-09	1.93E-05	6.42E-06	2.57E-05
acetaldehyde	4.73E-01	2.14E-01	4553.05	688.02	5241.07
acrolein	4.68E-01	2.92E-01	4512.19	937.14	5449.33
anthracene	5.00E-03	5.00E-03	48.18	16.06	64.24
benz(a)anthracene	6.20E-03	6.20E-03	59.74	19.91	79.66
benzene	6.60E-01	2.52E+00	6359.82	8094.31	14454.13
benzo(a)fluoranthene	2.60E-03	2.60E-03	25.05	8.35	33.41
benzo(a)pyrene	1.48E-03	1.48E-03	14.26	4.75	19.02
benzo(c)phenanthrene	3.90E-03	3.90E-03	37.58	12.53	50.11
benzo(e)pyrene	2.66E-03	2.66E-03	25.63	8.54	34.18
benzo(ghi)perylene	5.08E-03	5.08E-03	48.95	16.32	65.27
benzo(k)fluoranthene	2.60E-03	2.60E-03	25.05	8.35	33.41
benzofluoranthenes	5.14E-03	5.14E-03	49.53	16.51	66.04
carbonyl sulfide	5.34E-04	5.34E-04	5.15	1.72	6.86
chrysene	6.20E-03	6.20E-03	59.74	19.91	79.66
fluoranthene	6.73E-03	6.73E-03	64.81	21.60	86.42
formaldehyde	1.50E+00	5.80E+00	14454.13	18629.76	33083.89
indeno(1,2,3-cd)pyrene	3.41E-03	3.41E-03	32.86	10.95	43.81
methyl chloride	1.01E-02	4.83E-01	97.32	1551.41	1648.73
methylanthracene	8.23E-03	8.23E-03	79.30	26.43	105.74
methylbenzopyrenes	2.96E-03	2.96E-03	28.52	9.51	38.03
methylchrysene	7.90E-03	7.90E-03	76.13	25.38	101.50
methylpyrene, -fluoranthene	9.05E-03	9.05E-03	87.21	29.07	116.28
n-hexane	1.89E-02	8.91E-03	182.49	28.61	211.10
o,m,p-xylene	2.79E-01	1.31E-01	2683.65	420.78	3104.43
perylene	8.56E-04	8.56E-04	8.25	2.75	11.00
phenanthrene	5.00E-03	5.00E-03	48.18	16.06	64.24
pyrene	9.29E-03	9.29E-03	89.52	29.84	119.36
toluene	6.55E-01	3.08E-01	6311.94	989.66	7301.61

Methodology:**Approach:**

National emissions were estimated by multiplying an emission factor by the number of scrap tires that burn in open piles each year. These are scrap tire piles at recycling facilities and in legal and illegal dumps that accidentally catch fire, and should be distinguished from tires that are combusted in waste-to-energy facilities or in conventional combustion devices as a supplemental fuel.

All emission factors were obtained from AP-42 (Reference 1). The average number of tires that burn openly each year was estimated with advice from Dr. Jonathan Barnett, Center for Fire Safety Studies, WPI (Reference 2).

References:

1. U.S. Environmental Protection Agency. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, 5th Edition, AP-42*. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. 1995.
2. Barnett, Jonathan. Center for Fire Safety Studies, Worcester Polytechnic Institute, Worcester, MA. Personal communication with Eugene Paik, ERG. July 22, 1997. Estimating average number of scrap tire fires annually in the U.S.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Open Burning: Scrap Tires

Methodology:

Estimating emissions for the source category:				Open Burning: Scrap Tires					
Methodology:		National Activity x Emission Factor							
Activity:		(7,500,000 tires burned annually) x (20 lb/tire) = 75,000 tons tires burned/year							
	Pollutant	POLLID	Emission Factor (lb/1000 tons burned)			Activity (1000s of tons)	National Estimate (lb)	National Estimate (tons)	
			Chunk	Shredded	Average				
METALS	Antimony	41	5.88	4.73	5.31	75	397.88	0.20	
	Arsenic	11	0.10	0.40	0.25	75	18.75	0.01	
	Chromium	17	3.94	3.43	3.69	75	276.38	0.14	
	Lead	25	0.67	0.20	0.44	75	32.63	0.02	
	Nickel	30	4.74	2.15	3.45	75	258.38	0.13	
	Selenium	173	0.13	0.40	0.27	75	19.88	0.01	
PAHS	Acenaphthene	3112	1436.40	4771.20	3103.80	75	232785.00	116.39	
	Acenaphthylene	3113	1140.40	1136.17	1138.29	75	85371.38	42.69	
	Anthracene	3116	531.20	99.23	315.22	75	23641.13	11.82	
	Benz(a)anthracene	3114	15.80	207.43	111.62	75	8371.13	4.19	
	Benzo(a)pyrene	3115	347.60	230.32	288.96	75	21672.00	10.84	
	Benzo(b)fluoranthene	3117	366.20	178.14	272.17	75	20412.75	10.21	
	Benzo(g,h,i)perylene	3119	72.40	321.68	197.04	75	14778.00	7.39	
	Benzo(k)fluoranthene	3118	563.60	200.48	382.04	75	28653.00	14.33	
	Chrysene	3121	96.60	189.65	143.13	75	10734.38	5.37	
	Dibenzo(a,h)anthracene	3122	109.00	0.00	54.50	75	4087.50	2.04	
	Fluoranthene	3123	84.60	926.69	505.65	75	37923.38	18.96	
	Fluorene	3124	86.60	378.98	232.79	75	17459.25	8.73	
	Indeno(1,2,3-cd)pyrene	3125	117.20	172.76	144.98	75	10873.50	5.44	
	Naphthalene	3111	0.00	981.69	490.85	75	36813.38	18.41	
	Phenanthrene	3126	56.00	505.46	280.73	75	21054.75	10.53	
	Pyrene	3127	70.40	306.98	188.69	75	14151.75	7.08	
OTHER HAPS	Benzene	12	3052.79	3859.86	3456.33	75	259224.38	129.61	
	Biphenyl	89	380.16	659.29	519.73	75	38979.38	19.49	
	1,3-Butadiene	4	234.28	277.95	256.12	75	19208.63	9.60	
	Ethylbenzene	122	1079.44	1186.31	1132.88	75	84965.63	42.48	
	Phenol	163	675.41	1409.80	1042.61	75	78195.38	39.10	
	Styrene	32	1237.53	1299.84	1268.69	75	95151.38	47.58	
Sample Calculation*:		Antimony							
(5.31 lb)		(75,000 tons of tires burned)		= 397.88 lb of Antimony / year					
(1000 tons of tires burned)		(year)		= 0.20 tons of Antimony / year					
* due to rounding the estimate may not equal the exact product of the average emission factor and the activity.									

* due to rounding the estimate may not equal the exact product of the average emission factor and the activity.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Pesticide Application

Methodology:

Summary of Emission Estimation Method for Pesticide Application

The 1996 hexachlorobenzene (HCB) emission estimates for pesticide application were calculated by multiplying 1995 pollutant usage by the maximum HCB content to calculate the HCB available for release. It was then assumed that 8.4% of the HCB available for release will be volatilized into the atmosphere^{1,5}. Estimates of pesticide usage and HCB content were provided in response memos to the September 1996 Draft Report of Emission Inventory of Section 112(c)(6) Pollutants¹⁻⁵. National estimates for pollutants other than HCB are currently being developed, but are not expected to be available until sometime after June 1999.

Example Calculation:

70,500,000 lb of Atrazine was used in 1995^{4,5}. We are given a maximum HCB concentration of 0.0001%^{4,5}. Multiplying these two figures gives us the HCB available for release.

$70,500,000 \text{ lb Atrazine} \times 0.0001\% = 70.50 \text{ lb available for release}$

Assuming that 8.4% of the amount available for release is volatilized,

$70.50 \text{ lb Atrazine} \times 8.4\% \times (1 \text{ ton}/2000 \text{ lb}) = 0.003 \text{ ton per year HCB}$

References:

1. Steve McMaster, DowElanco. Memorandum to Laurel Driver, U.S. Environmental Protection Agency, "EPA's Draft Emissions Inventory Report for Clean Air Act Section 112(c)(6) Pollutants and Source Categories." November 27, 1996.
2. Robert Bailey, Bailey Associates. Memorandum to Anne Pope, U.S. Environmental Protection Agency/Emissions Monitoring and Analysis Division, "CAAA Sec 112 (c)(6) Pollutants, HCB Emissions. December 5, 1996.
3. Edward Noble, ISK Biosciences Corp. Memorandum to Laurel Driver, U.S. Environmental Protection Agency, "Re: US EPA Draft Report, 'Emissions Inventory of Section 112(c)(6) Pollutants:...' Dated September, 1996." November 26, 1996.
4. Thomas Gilding, American Crop Protection Association. Memorandum to Laurel Driver, Environmental Protection Agency, "Re: EPA's Draft Emissions Inventory Report for Section 112(c)(6) Pollutants and Source Categories." November 27, 1996.
5. Thomas Parshley, Ciba Crop Protection. Memorandum to Laurel Driver, Environmental Protection Agency, "Comments on Draft EPA Report of Emission Inventory for the Clean Air Act Section 112(c) Pollutants and Source Categories." November 27, 1996.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Pesticide Application

Methodology:

Hexachlorobenzene Emissions from Pesticide Application (base year 1995)						
Compound	Amount Used in US Agriculture, lb/yr	HCB Content (%)	HCB Available for Release (lb/yr)	% Volatilized ¹⁻²	HCB Emissions (lb/yr)	HCB Emissions (tons/yr)
Picloram ¹⁻²	1,000,000	0.005	50.0	8.4	4.2	0.0021
Chlorothalonil ³	11,566,093	0.005	578.3	8.4	49	0.024
PCNB ³	1,662,371	0.05	831.2	8.4	70	0.035
Atrazine ⁴	70,500,000	0.0001	70.5	8.4	5.9	0.0030
Simazine ⁴	4,000,000	0.0001	4.0	8.4	0.34	1.7E-04
DCPA (Dacthal) ^{2, 5}	1,340,000	0.10	1,340.0	8.4	113	0.056
Lindane ³	61,189	0.01	6.1	8.4	0.51	2.6E-04
Total					242	0.12
References:						
1. Steve McMaster, Dow Elanco. Memorandum to Laurel Driver, U.S. Environmental Protection Agency, "EPA's Draft Inventory Report for Clean Air Act Section 112(c)(6) Pollutants and Source Categories." November 27, 1996						
2. Thomas Gilding, American Crop Protection Association. Memorandum to Laurel Driver, Environmental Protection Agency, "Re: EPA's Draft Emissions Inventory Report for Section 112(c)(6) Pollutants and Source Categories." November 27, 1996.						
3. Robert Bailey, Bailey Associates. Memorandum to Anne Pope, U.S. Environmental Protection Agency/Emissions Monitoring and Analysis Division, "CAAA Sec 112 (c)(6) Pollutants, HCB Emissions. December 5, 1996.						
4. Thomas Parshley, Ciba Crop Protection. Memorandum to Laurel Driver, Environmental Protection Agency, "Comments on Draft EPA Report of Emission Inventory for the Clean Air Act Section 112(c) Pollutants and Source Categories." November 27, 1996.						
5. Edward Noble, ISK Biosciences Corp. Memorandum to Laurel Driver, U.S. Environmental Protection Agency, "Re: US EPA Draft Report, 'Emissions Inventory of Section 112(c)(6) Pollutants:...' Dated September, 1996." November 26, 1996.						

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Residential Heating: Anthracite Coal

Methodology:

The activity level for residential anthracite coal combustion comes from the State Energy Data Report (Reference 1). The heating value conversion is from AP-42 (Reference 2).

The Emission Standards Division (Reference 3) supplied emission factors based on AP-42 (Reference 2) for the two sets of HAPs listed below. These emission factors are from 10 facilities firing bituminous, 8 facilities firing subbituminous, and 1 facility firing lignite. Factors apply to boilers utilizing both wet limestone scrubbers or spray dryers with an electrostatic precipitator or fabric filter. In addition, the factors apply to boilers utilizing only an electrostatic precipitator or fabric filter:

Acetophenone	Ethylbenzene	Methyl Bromide	Propionaldehyde
Carbon Disulfide	Hexane	Methyl Ethyl Ketone	Toluene
Chlorobenzene	Isophorone	Phenol	
Acetaldehyde	Bis(2-Ethylhexyl)phthalate	Methyl Chloride	Styrene
Acrolein	Ethylene Dichloride	Methylene Chloride	Tetrachloroethylene
Benzene	Formaldehyde		

The Emission Standards Division (Reference 3) also supplied emission factors based on AP-42 (Reference 2) for antimony, cobalt, selenium, arsenic, beryllium, cadmium, chromium, lead, manganese, mercury, and nickel. These emission factors are from 11 facilities firing bituminous coal, 15 facilities firing subbituminous coal, and 2 facilities firing lignite. Factors apply to boilers utilizing either venturi scrubbers, spray dryer absorbers, or wet limestone scrubbers with an electrostatic precipitator or fabric filter. In addition, the factors apply to boilers utilizing only an electrostatic precipitator, fabric filter, or venturi scrubber.

The Emission Standards Division (Reference 3) supplied emission factors for hydrogen chloride and hydrogen fluoride based on AP-42 data (Reference 2), and the Emission Standards Division (Reference 3) supplied emission factors for dioxins/furans (as toxic equivalency units) and POM as 16-PAH.

The emission factors for acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b,j,k)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene were obtained from AP-42 (Reference 2). These emission factors are from six sites firing bituminous coal, four sites firing subbituminous coal, and one site firing lignite. Factors apply to boilers using either wet limestone scrubbers or spray dryers with an electrostatic precipitator or fabric filter. In addition, the factors apply to boilers using only an electrostatic precipitator or fabric filter. The emission factor for POM as EOM of 1.35 pound per short ton of coal was obtained from the 112(c)(6) report (Reference 4).

References:

1. Energy Information Administration (EIA). *State Energy Data Report, 1995 Consumption Estimates*. U.S. Department of Energy, Washington, D.C. DOE/EIA-0214(95). 1997.
2. U.S. Environmental Protection Agency. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42*. Research Triangle Park, North Carolina. 1996.
3. Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. November 13, 1998.
4. U.S. Environmental Protection Agency. *1990 Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report*. Research Triangle Park, North Carolina. June 1997.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Residential Heating: Anthracite Coal

Methodology:

Nationwide Emissions from Residential Anthracite Coal Combustion, 1995				
	Emission Factor	Emission Factor	National Activity Level	National Emissions
Pollutant	(lb/ton coal)	Reference	(Reference 1) (tons coal burned/year)	(tons/year)
acenaphthene	5.1E-07	Reference 3	6.36E+05	1.62E-04
acenaphthylene	2.5E-07	Reference 3	6.36E+05	7.95E-05
acetophenone	1.5E-05	Reference 2, 3	6.36E+05	4.77E-03
anthracene	2.1E-07	Reference 3	6.36E+05	6.68E-05
antimony	1.8E-05	Reference 2, 3	6.36E+05	5.72E-03
benz(a)anthracene	8.0E-08	Reference 3	6.36E+05	2.54E-05
benzo(a)pyrene	3.8E-08	Reference 3	6.36E+05	1.21E-05
benzo(b,j,k)fluoranthene	1.1E-07	Reference 3	6.36E+05	3.50E-05
benzo(g,h,i)perylene	2.7E-08	Reference 3	6.36E+05	8.59E-06
carbon disulfide	1.3E-04	Reference 2, 3	6.36E+05	4.13E-02
chlorobenzene	2.2E-05	Reference 2, 3	6.36E+05	7.00E-03
chrysene	1.0E-07	Reference 3	6.36E+05	3.18E-05
cobalt	1.0E-04	Reference 2, 3	6.36E+05	3.18E-02
ethylbenzene	9.4E-05	Reference 2, 3	6.36E+05	2.99E-02
fluoranthene	7.1E-07	Reference 3	6.36E+05	2.26E-04
fluorene	9.1E-07	Reference 3	6.36E+05	2.89E-04
hexane	6.7E-05	Reference 2, 3	6.36E+05	2.13E-02
hydrogen chloride	1.2E+00	Reference 2, 3	6.36E+05	3.82E+02
hydrogen fluoride	1.5E-01	Reference 2, 3	6.36E+05	4.77E+01
indeno(1,2,3-cd)pyrene	6.1E-08	Reference 3	6.36E+05	1.94E-05
isophorone	5.8E-04	Reference 2, 3	6.36E+05	1.84E-01
methyl bromide	1.6E-04	Reference 2, 3	6.36E+05	5.09E-02
methyl ethyl ketone	3.9E-04	Reference 2, 3	6.36E+05	1.24E-01
naphthalene	1.3E-05	Reference 3	6.36E+05	4.13E-03
phenanthrene	2.7E-06	Reference 3	6.36E+05	8.59E-04
phenol	1.6E-05	Reference 3	6.36E+05	5.09E-03
propionaldehyde	3.8E-04	Reference 2, 3	6.36E+05	1.21E-01
pyrene	3.3E-07	Reference 3	6.36E+05	1.05E-04
selenium	1.3E-03	Reference 2, 3	6.36E+05	4.13E-01
toluene	2.4E-04	Reference 2, 3	6.36E+05	7.63E-02
Example Calculation:				
National Activity Level (tons/year)=		6.36E+05		
National emissions (tons/year) = Emission Factor (lb/ton) x National Activity Level (tons/year)/2,000 lb/ton				
National toluene emissions = 0.00024 x 636,000/2,000 = 0.0763 tons/year				
References:				
1. Energy Information Administration (EIA). State Energy Data Report 1995, Consumption Estimates. U.S. Department of Energy, Washington, D.C. DOE/EIA-0214(95). 1997.				
2. Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. November 13, 1998.				
3. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. 1996.				

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Residential Heating: Anthracite Coal

Methodology:

Nationwide Emissions from Residential Anthracite Coal Combustion, 1995				
Pollutant	Emission Factor (lb/ton coal)	Emission Factor Reference	National Activity Level (Reference 4) (tons coal burned/year)	National Emissions (tons/year)
acetaldehyde	5.7E-04	Reference 2, 3	6.36E+05	1.81E-01
acrolein	2.9E-04	Reference 2, 3	6.36E+05	9.22E-02
arsenic	4.1E-04	Reference 2, 3	6.36E+05	1.30E-01
benzene	1.3E-03	Reference 2, 3	6.36E+05	4.13E-01
beryllium	2.1E-05	Reference 2, 3	6.36E+05	6.68E-03
bis(2-ethylhexyl)phthalate	7.3E-05	Reference 2, 3	6.36E+05	2.32E-02
cadmium	5.1E-05	Reference 2, 3	6.36E+05	1.62E-02
chromium	2.6E-04	Reference 2, 3	6.36E+05	8.27E-02
dioxins/furans as TEQ	3.5E-12	Reference 2	6.36E+05	1.11E-09
ethylene dichloride	4.0E-05	Reference 2, 3	6.36E+05	1.27E-02
formaldehyde	2.4E-04	Reference 2, 3	6.36E+05	7.63E-02
lead	4.2E-04	Reference 2, 3	6.36E+05	1.34E-01
manganese	4.9E-04	Reference 2, 3	6.36E+05	1.56E-01
mercury	8.3E-05	Reference 2, 3	6.36E+05	2.64E-02
methyl chloride	5.3E-04	Reference 2, 3	6.36E+05	1.69E-01
methylene chloride	2.9E-04	Reference 2, 3	6.36E+05	9.22E-02
nickel	2.8E-04	Reference 2, 3	6.36E+05	8.90E-02
POM as EOM	1.35E+00	Reference 1	6.36E+05	4.29E+02
styrene	2.5E-05	Reference 2, 3	6.36E+05	7.95E-03
tetrachloroethylene	4.3E-05	Reference 2, 3	6.36E+05	1.37E-02
Example Calculation: National emissions (tons/year) = Emission Factor (lb/ton) x National Activity Level (tons/year)/2,000 lb/ton National acetaldehyde emissions = 0.00057 x 636,000/2,000 = 0.181 tons/year References: 1. U.S. Environmental Protection Agency. 1990 Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzo-furan (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report. Research Triangle Park, North Carolina. June 1997. 2. Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. November 13, 1998. 3. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. 1996. 4. Energy Information Administration (EIA). State Energy Data Report 1995, Consumption Estimates. U.S. Department of Energy, Washington, D.C. DOE/EIA-0214(95). 1997.				

Methodology:

The activity level for residential bituminous and lignite coal combustion comes from the State Energy Data Report (Reference 1). The heating value conversion is from the Energy Information Administration (Reference 2).

The Emission Standards Division (Reference 3) supplied emission factors based on AP-42 (Reference 4) for the two sets of HAPs listed below. These emission factors are from 10 facilities firing bituminous coal, eight facilities firing subbituminous coal, and one facility firing lignite. Factors apply to boilers utilizing both wet limestone scrubbers or spray dryers with an electrostatic precipitator or fabric filter. In addition, the factors apply to boilers utilizing only an electrostatic precipitator or fabric filter:

Acetaldehyde	Bis(2-Ethylhexyl)phthalate	Methyl Chloride	Styrene
Acrolein	Ethylene Dichloride	Methylene Chloride	Tetrachloroethylene
Benzene	Formaldehyde		
Acetophenone	Ethylbenzene	Methyl Bromide	Propionaldehyde
Carbon Disulfide	Hexane	Methyl Ethyl Ketone	Toluene
Chlorobenzene	Isophorone	Phenol	

The Emission Standards Division (Reference 3) supplied emission factors based on AP-42 (Reference 4) for arsenic, beryllium, cadmium, chromium, lead, manganese, mercury, nickel, antimony, cobalt, and selenium. These emission factors are from 11 facilities firing bituminous coal, 15 facilities firing subbituminous coal, and two facilities firing lignite. Factors apply to boilers utilizing either venturi scrubbers, spray dryer absorbers, or wet limestone scrubbers with an electrostatic precipitator or fabric filter. In addition, the factors apply to boilers utilizing only an electrostatic precipitator, fabric filter, or venturi scrubber.

The Emission Standards Division (Reference 3) supplied emission factors for dioxins/furans (as toxic equivalency or TEQ units), individual PAHs, hydrogen chloride, and hydrogen fluoride based on AP-42 data (Reference 4). The emission factors for the individual PAHs were obtained from AP-42 (Reference 4). The individual PAHs were acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b,j,k)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. These emission factors are from six sites firing bituminous coal, four sites firing subbituminous coal, and one site firing lignite. Factors apply to boilers using either wet limestone scrubbers or spray dryers with an electrostatic precipitator or fabric filter. In addition, the factors apply to boilers using only an electrostatic precipitator or fabric filter. The emission factor for POM as EOM of 1.35 pound per short ton of coal was obtained from the Section 112(c)(6) report (Reference 5).

References:

1. Energy Information Administration. *State Energy Data Report, 1995 Summaries*. U.S. Department of Energy, Washington, D.C. p. 22, 1997.
2. Energy Information Administration. *State Energy Data Report*. Office of Energy Markets and End Use, U.S. Department of Energy, Washington, D.C. p. 475, 1992.
3. Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. November 13, 1998.
4. U.S. Environmental Protection Agency. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42*. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. 1996
5. U.S. Environmental Protection Agency. *1990 Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report*. Research Triangle Park, North Carolina. June 1997.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Residential Heating: Bituminous and Lignite Coal

Methodology:

Nationwide Emissions from Residential Bituminous and Lignite Coal Combustion, 1995				
Pollutant	Emission Factor (lb/ton coal)	Emission Factor Reference	National Activity Level (References 1, 4) (tons coal burned/year)	National Emissions (tons/year)
acetaldehyde	5.7E-04	Reference 2, 3	1.68E+06	4.79E-01
acrolein	2.9E-04	Reference 2, 3	1.68E+06	2.44E-01
arsenic	4.1E-04	Reference 2, 3	1.68E+06	3.44E-01
benzene	1.3E-03	Reference 2, 3	1.68E+06	1.09E+00
beryllium	2.1E-05	Reference 2, 3	1.68E+06	1.76E-02
bis(2-ethylhexyl)phthalate	7.3E-05	Reference 2, 3	1.68E+06	6.13E-02
cadmium	5.1E-05	Reference 2, 3	1.68E+06	4.28E-02
chromium	2.6E-04	Reference 2, 3	1.68E+06	2.18E-01
dioxins/furans (TEQ units)	3.5E-12	Reference 2	1.68E+06	2.94E-09
ethylene dichloride	4.0E-05	Reference 2, 3	1.68E+06	3.36E-02
formaldehyde	2.4E-04	Reference 2, 3	1.68E+06	2.02E-01
lead	4.2E-04	Reference 2, 3	1.68E+06	3.53E-01
manganese	4.9E-04	Reference 2, 3	1.68E+06	4.12E-01
mercury	8.3E-05	Reference 2, 3	1.68E+06	6.97E-02
methyl chloride	5.3E-04	Reference 2, 3	1.68E+06	4.45E-01
methylene chloride	2.9E-04	Reference 2, 3	1.68E+06	2.44E-01
nickel	2.8E-04	Reference 2, 3	1.68E+06	2.35E-01
POM as EOM	1.35E+00	Reference 1	1.68E+06	1.13E+03
styrene	2.5E-05	Reference 2, 3	1.68E+06	2.10E-02
tetrachloroethylene	4.3E-05	Reference 2, 3	1.68E+06	3.61E-02
Example Calculation:				
Assumes same heating value (Btu/lb) as 1990. 1995 activity calculated as follows:				
National Activity 1990 (tons)/Btu consumption 1990 = National Activity 1995 (tons)/Btu consumption 1995				
National Activity 1996 (tons) = (1.93E6 tons/43.4E12 Btu) x 37.8E12 Btu = 1.68E6 tons/year				
National emissions (tons/year) = Emission Factor (lb/ton) x National Activity Level (tons/year)/2,000 lb/ton				
National acetaldehyde emissions = 0.00057 x 1,680,000/2,000 = 0.479 tons/year				
References:				
1. U.S. Environmental Protection Agency. 1990 Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report. Research Triangle Park, North Carolina. June 1997.				
2. Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. November 13, 1998.				
3. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. 1996.				
4. Energy Information Administration (EIA). State Energy Data Report, 1995 Summaries. U.S. Department of Energy, Washington, D.C. p. 22, 1997.				

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Residential Heating: Bituminous and Lignite Coal

Methodology:

Nationwide Emissions from Residential Bituminous and Lignite Coal Combustion, 1995				
Pollutant	Emission Factor (lb/ton coal)	Emission Factor Reference	National Activity Level (References 1, 3) (tons coal burned/year)	National Emissions (tons/year)
acenaphthene	5.1E-07	Reference 4	1.68E+06	4.29E-04
acenaphthylene	2.5E-07	Reference 4	1.68E+06	2.11E-04
acetophenone	1.5E-05	Reference 2, 4	1.68E+06	1.26E-02
anthracene	2.1E-07	Reference 4	1.68E+06	1.77E-04
antimony	1.8E-05	Reference 2, 4	1.68E+06	1.52E-02
benz(a)anthracene	8.0E-08	Reference 4	1.68E+06	6.74E-05
benzo(a)pyrene	3.8E-08	Reference 4	1.68E+06	3.20E-05
benzo(b,j,k)fluoranthene	1.1E-07	Reference 4	1.68E+06	9.26E-05
benzo(g,h,i)perylene	2.7E-08	Reference 4	1.68E+06	2.27E-05
carbon disulfide	1.3E-04	Reference 2, 4	1.68E+06	1.09E-01
chlorobenzene	2.2E-05	Reference 2, 4	1.68E+06	1.85E-02
chrysene	1.0E-07	Reference 4	1.68E+06	8.42E-05
cobalt	1.0E-04	Reference 2, 4	1.68E+06	8.42E-02
ethylbenzene	9.4E-05	Reference 2, 4	1.68E+06	7.92E-02
fluoranthene	7.1E-07	Reference 4	1.68E+06	5.98E-04
fluorene	9.1E-07	Reference 4	1.68E+06	7.66E-04
hexane	6.7E-05	Reference 2, 4	1.68E+06	5.64E-02
hydrogen chloride	1.2E+00	Reference 2, 4	1.68E+06	1.01E+03
hydrogen fluoride	1.5E-01	Reference 2, 4	1.68E+06	1.26E+02
indeno(1,2,3-cd)pyrene	6.1E-08	Reference 4	1.68E+06	5.14E-05
isophorone	5.8E-04	Reference 2, 4	1.68E+06	4.88E-01
methyl bromide	1.6E-04	Reference 2, 4	1.68E+06	1.35E-01
methyl ethyl ketone	3.9E-04	Reference 2, 4	1.68E+06	3.28E-01
naphthalene	1.3E-05	Reference 4	1.68E+06	1.09E-02
phenanthrene	2.7E-06	Reference 4	1.68E+06	2.27E-03
phenol	1.6E-05	Reference 2	1.68E+06	1.35E-02
propionaldehyde	3.8E-04	Reference 2, 4	1.68E+06	3.20E-01
pyrene	3.3E-07	Reference 4	1.68E+06	2.78E-04
selenium	1.3E-03	Reference 2, 4	1.68E+06	1.09E+00
toluene	2.4E-04	Reference 2, 4	1.68E+06	2.02E-01
Example Calculation:				
National emissions (tons/year) = Emission Factor (lb/ton) x National Activity Level (tons/year)/2,000 lb/ton				
National toluene emissions = 0.00024 x 1,680,000/2000 = 0.202 tons/year				
References:				
1. Energy Information Administration (EIA). State Energy Data Report, 1995 Summaries. U.S. Department of Energy, Washington, D.C. p. 22, 1997.				
2. Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. November 13, 1998.				
3. Energy Information Administration (EIA). State Energy Data Report. Office of Energy Markets and End Use, U.S. Department of Energy, Washington, D.C. pp 39-344, 1992.				
4. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. 1996.				
Conversion of Activity level in Btu into tons of bituminous and lignite coal:				
Activity level, btu =	37.8 trillion Btu/yr	residential bituminous and lignite use		
	Heating value, bituminous and lignite =	11222	btu/lb	
trillion btu =	1.00E+12 btu	ton =	2000 lb	
Activity level, bituminous and lignite, tons =	1.68E+06	tons/yr		

Methodology:

There are 1.01×10^7 homes that use distillate fuel as their primary heat source (Reference 1).

The activity comes from the *State Energy Data Report* (Reference 2).

The Emission Standards Division (Reference 3) supplied emission factors based on AP-42 (Reference 4) for benzene, formaldehyde, and individual PAHs. These PAHs are: acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(b,k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. Data are for residual oil-fired boilers. The formaldehyde emission factor is based only on data from utilities using No. 6 oil. The higher heating value for distillate oil comes from the Emission Standards Division (Reference 3).

The Emission Standards Division (Reference 3) supplied emission factors based on AP-42 (Reference 4) for arsenic, beryllium, cadmium, chromium, lead, manganese, mercury, nickel and selenium. Data are for distillate oil-fired boilers.

The Emission Standards Division (Reference 3) also supplied an emission factor for acetaldehyde.

References:

1. U.S. Environmental Protection Agency. *1990 Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD)/ 2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report.* Research Triangle Park, North Carolina. June 1997.
2. Energy Information Administration. *State Energy Data Report, 1995 Summaries.* U.S. Department of Energy, Washington, D.C. p. 12. 1997.
3. Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. November 13, 1998.
4. U.S. Environmental Protection Agency. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42.* Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Residential Heating: Distillate Oil

Methodology:

Nationwide Emissions from Residential Distillate Oil Combustion, 1995				
Pollutant	Emission Factor (lb/MM Btu Oil)	Emission Factor Reference	National Activity Level (Reference 1) (MM Btu oil burned/year)	National Emissions (tons/year)
Acenaphthene	1.5E-07	Reference 3	8.83E+08	6.65E-02
Acenaphthylene	1.8E-09	Reference 3	8.83E+08	7.98E-04
Acetaldehyde	3.5E-05	Reference 2	8.83E+08	1.55E+01
Anthracene	8.7E-09	Reference 3	8.83E+08	3.85E-03
Arsenic	4.0E-06	Reference 2, 3	8.83E+08	1.77E+00
Benz(a)anthracene	2.9E-08	Reference 3	8.83E+08	1.26E-02
Benzene	1.5E-06	Reference 2, 3	8.83E+08	6.62E-01
Benzo(b,k)fluoranthene	1.1E-08	Reference 3	8.83E+08	4.67E-03
Benzo(g,h,i)perylene	1.6E-08	Reference 3	8.83E+08	7.13E-03
Beryllium	3.0E-06	Reference 2, 3	8.83E+08	1.32E+00
Cadmium	3.0E-06	Reference 2, 3	8.83E+08	1.32E+00
Chromium	3.0E-06	Reference 2, 3	8.83E+08	1.32E+00
Chrysene	1.7E-08	Reference 3	8.83E+08	7.51E-03
Dibenzo(a,h)anthracene	1.2E-08	Reference 3	8.83E+08	5.27E-03
Fluoranthene	3.5E-08	Reference 3	8.83E+08	1.53E-02
Fluorene	3.2E-08	Reference 3	8.83E+08	1.41E-02
Formaldehyde	2.4E-04	Reference 2, 3	8.83E+08	1.06E+02
Indeno(1,2,3-c,d)pyrene	1.5E-08	Reference 3	8.83E+08	6.75E-03
Lead	9.0E-06	Reference 2, 3	8.83E+08	3.97E+00
Manganese	6.0E-06	Reference 2, 3	8.83E+08	2.65E+00
Mercury	3.0E-06	Reference 2, 3	8.83E+08	1.32E+00
Naphthalene	8.1E-06	Reference 3	8.83E+08	3.56E+00
Nickel	3.0E-06	Reference 2, 3	8.83E+08	1.32E+00
Phenanthrene	7.5E-08	Reference 3	8.83E+08	3.31E-02
Pyrene	3.0E-08	Reference 3	8.83E+08	1.34E-02
Selenium	1.5E-05	Reference 2, 3	8.83E+08	6.62E+00
References:				
1. Energy Information Administration (EIA). State Energy Data Report, 1995 Summaries. U.S. Department of Energy, Washington, D.C. p. 12, 1997.				
2. Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. November 13, 1998.				
3. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, 5th Edition, AP-42. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. 1996.				
Conversion of 1995 Activity level in trillion Btu to MM Btu				
Activity level, trillion Btu =	8.83E+14	trillion Btu/year		
		divided by:	1.00E+06	Btu/MM Btu
Activity level, MM Btu =		8.83E+08	MM Btu/yr	

Methodology:

National activity level estimates were provided by the U.S. Department of Energy (Reference 1).

The Emission Standards Division (Reference 2) supplied emission factors based on AP-42 (Reference 3) for benzene, formaldehyde, and individual PAHs. These PAHs are fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene. Emission factors were calculated from data reported above the method detection limit. Data are for all natural gas (NG) combustion sources. The higher heating value for natural gas was supplied by the emissions standards division (Reference 2).

The Emission Standards Division (Reference 2) also supplied an emission factor for acetaldehyde.

References:

1. Energy Information Administration (EIA). *State Energy Data Report, 1995 Summaries*. U.S. Department of Energy, Washington, D.C. p. 12, 1997.
2. Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. November 13, 1998.
3. U.S. Environmental Protection Agency. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42*. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. 1998

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Residential Heating: Natural Gas

Methodology:

Nationwide Emissions from Residential Natural Gas Combustion, 1995				
Pollutant	Emission Factor (lb/MM Btu NG)	Emission Factor Reference	National Activity Level (Reference 1) (MM Btu NG burned/year)	National Emissions (tons/year)
Acetaldehyde	1.3E-08	Reference 2	4.98E+09	3.24E-02
Benzene	2.1E-06	Reference 2, 3	4.98E+09	5.23E+00
Fluoranthene	3.0E-09	Reference 2, 3	4.98E+09	7.47E-03
Fluorene	2.8E-09	Reference 2, 3	4.98E+09	6.97E-03
Formaldehyde	7.5E-05	Reference 2, 3	4.98E+09	1.87E+02
Naphthalene	6.1E-07	Reference 2, 3	4.98E+09	1.52E+00
Phenanthrene	1.7E-08	Reference 2, 3	4.98E+09	4.23E-02
Pyrene	5.0E-09	Reference 2, 3	4.98E+09	1.25E-02
References:				
1. Energy Information Administration (EIA). State Energy Data Report, 1995 Summaries. U.S. Department of Energy, Washington, D.C. P. 12, 1997.				
2. Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. November 13, 1998.				
3. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, Volume I: Point and Area Sources, Fifth Edition, AP-42. Office of Air Quality Planning and Standards. Triangle Park, North Carolina. 1998.				
Conversion of Activity level in Btu to MM Btu				
Activity level, Btu =	4.98E+15	Btu/yr		
		MM Btu =	1.00E+06	Btu
Activity level, MM Btu =		4.98E+09	MM Btu/yr	

Methodology:

The estimates of national emissions from residential wood combustion (RWC) have large uncertainties due to the paucity of emission factor data, the very large number of dissimilar individual sources that make up the category, and the low quality of the few emission factors that have been developed.

Based on the U.S. Department of Energy¹ and other survey data²⁻⁵, it has been estimated that there were 25 million residential wood burning appliances in use in the 1990 base year. Of these, approximately 16 million were fireplaces and 9 million were wood stoves. Of the 9 million wood stoves, about 8.5 million were conventional non-certified wood stoves and 0.5 million were certified wood stoves. There are many hundreds of types or models of wood burning appliances in use; many dozens of tree species are commonly used for wood fuel; draft characteristics (chimney conditions) vary from home to home; household altitude is variable; there are variations in fuel wood seasoning and storage practices (wood moisture); and there are wide variations in home owner operation of wood burning devices (burn rate, burn duration, fuel size, damper setting, and kindling approach). The combination of a wide range of combustion conditions and the substantial differences in fuel chemistry has the effect of making pollutant emissions for RWC highly variable from individual appliance to appliance.

The controls implemented are as follows: catalytic woodstoves control emissions by the same means as an automobile's catalytic converter; non-catalytic woodstoves use secondary combustion chambers and baffles; and fireplaces are uncontrolled.⁶

The nationwide percentage of residential wood consumption is 28% for fireplaces and 72% for woodstoves.⁷ Based on Hearth Products Association surveys and a survey conducted by the U.S. Department of Energy, an estimate of the relative woodstove appliance usage for 1990 is as follows:

non-certified conventional woodstoves: 95 %
combined certified non-catalytic and catalytic stoves: 5 %.

Of the 5% that are certified stoves, the breakdown between non-catalytic and catalytic is 50/50.⁸

The urban/rural split is 40.9/59.1 for arsenic, cadmium, chromium, formaldehyde, lead, manganese, mercury, and nickel; and 32.1/67.9 for dioxins/furans, acenaphthene, acenaphthylene, anthracene, benzo(g,h,i)perylene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene. The urban/rural split is 35.7/64.3 for 7-PAH, benz(a)anthracene, benzo(b,k)fluoranthrene, benzo(a)pyrene, chrysene, and indeno(1,2,3-c,d)pyrene.⁹

Emission factors for formaldehyde, arsenic, cadmium, chromium, lead, mercury, and manganese were supplied by the Emissions Standards Division¹⁰ based on information in the AP-42 database.¹¹ The conversion factor of 4500 Btu/lb fuel burned is also taken directly from the AP-42 database.¹¹ All emission factors were taken from uncontrolled combustors.

The Emission Standards Division¹⁰ also supplied emission factors for individual PAHs, dioxins/furans in toxic equivalency (TEQ) units, hydrogen chloride, and nickel.

Using U.S. Department of Energy estimates¹² for residential wood consumption, the 1996 base year activity level was calculated. Emission factors, heating values, and urban/rural split data were assumed to be the same as 1990 base year.

References:

1. Energy Information Administration. 1993, *Household Energy Consumption and Expenditures 1990*, DOE/EIA-0321(90). U.S. Department of Energy, Washington, D.C. 1993.
2. Simmons Market Research Bureau, Inc. *The 1990 Study of Media and Markets*. 1990.

Methodology:

3. Mediamark Research Inc. *Household & Personal Appliances, Etc. Report*. 1989.
4. U.S. Consumer Product Safety Commission. *Room Heating Equipment Exposure Survey, Final Report*, OMB Control No. 3041-0083. 1989
5. Smith, Bucklin & Associates, Inc., Market Research & Statistics Division. The 1991 Confidential Manufacturing Study, EPA Certified Cord Wood Burning Appliances, report to Hearth Products Association, Arlington, VA. 1992.
6. U.S. Environmental Protection Agency. *National Urban Area Source Emissions of Benzene, 1,3-Butadiene, Formaldehyde, Trichloroethylene, Perchloroethylene, Methylene Chloride, and Carbon Tetrachloride. Final Report*. Research Triangle Park, North Carolina. March 1996.
7. U.S. Environmental Protection Agency. *1990 Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report*. Research Triangle Park, North Carolina. June 1997.
8. Houck, Jim, OMNI Environmental Services, Inc. Memorandum to Adam Langmaid, Eastern Research Group. Wood burning appliance use base year 1990. July 8, 1997.
9. Houck, Jim, OMNI Environmental Service, Inc., Memorandum to Joe Mangino, Eastern Research Group. Urban/Rural Allocation of Residential Wood Combustion Emissions -- Section 112(k). November 19, 1997.
10. Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. EPA/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources -- Interim Final Report," September 18, 1998. November 13, 1998.
11. U.S. Environmental Protection Agency. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition and Supplements, AP-42*. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. 1996
12. Energy Information Administration (EIA). *Renewable Energy Annual 1997, Volume I, Chapter 1*. Downloaded from the EIA website:
www.eia.doe.gov/cneaf/solar.renewables/renewable.energy.annual/rea97/chap1.html.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Reside

Methodology:

Activity:	6.61E+07	ton from residential sector in 1996 (EA Renewable Energy Annual 1997)		
	Activity = 595 E12 Btu/year x lb/4500 Btu x ton/2000 lb =	6.61 E07 ton/year		
				Estimate
Pollutant Name		Factor (lb/ton)		(tons/yr)
Acenaphthene		4.10E-06		1.36E-01
Acenaphthylene		4.76E-05		1.57E+00
Anthracene		3.30E-06		1.09E-01
Arsenic & Compounds (inorganic including Arsine)		8.5E-05		2.81E+00
Benz(a)anthracene		3.27E-06		1.08E-01
Benzo(a)pyrene		6.75E-08		2.23E-03
Benzo(b,k)fluoranthene		2.90E-05		9.58E-01
Benzo(g,h,i)perylene		1.41E-06		4.66E-02
Cadmium and Compounds		2.1E-05		6.94E-01
Chromium and Compounds		1.6E-04		5.29E+00
Chrysene		4.20E-07		1.39E-02
Dioxins/Furans (as TEQ units)		2.5E-09		8.26E-05
Fluoranthene		1.83E-05		6.05E-01
Fluorene		8.22E-06		2.72E-01
Formaldehyde		8.2E-03		2.71E+02
Hydrogen Chloride		7.8E-03		2.58E+02
Indeno(1,2,3-c,d)pyrene		3.60E-07		1.19E-02
Lead and Compounds		4.5E-04		1.49E+01
Manganese and Compounds		1.3E-02		4.30E+02
Mercury and Compounds		5.2E-06		1.72E-01
Naphthalene		3.39E-03		1.12E+02
Nickel and Compounds		2.1E-05		6.94E-01
Phenanthrene		5.20E-05		1.72E+00
Pyrene		1.67E-05		5.52E-01
Sample calculation:				
0.000085 lb Arsenic		6.61 e+7 tons of wood/w ood residue		1 ton Arseinic
ton of wood/w ood w aste burned w ith 50% moisture				2000 lb Arsenic

Methodology:

Summary of Emission Estimation Method for Softwood Drying Kilns

National level emissions of acetaldehyde and formaldehyde from softwood drying kilns are taken from the *1990 Emissions Inventory of Section 112 (k) Pollutants* (Reference 1). The estimates in the Section 112(k) inventory are provided by the National Council of the Paper Industry for Air and Stream Improvement, Inc. for 1990 (Reference 2). At the time the estimates were provided, it was acknowledged that due to large uncertainties in the emission factors, which were still under review, total nation wide estimates could differ from the preliminary estimates provided.

References:

- 1) U.S. Environmental Protection Agency. *1990 Emissions Inventory of Forty Section 112(k) Pollutants*. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. April 1999.
- 2) National Council of the Paper Industry for Air and Stream Improvement, Inc. to L. McKelvey, U.S. Environmental Protection Agency. Comments regarding the Draft Integrated Urban Air Toxics Strategy. November 19, 1998.

Methodology:

Structure Fires

The 1996 emissions from structure fires were estimated using the method and some of the data inputs described in the air toxics emissions inventory for Chicago (Reference 1). The method described in the Chicago inventory multiplies volumetric emissions factors and heating value factors developed for the Chicago inventory times the fuel-factor (F-factor) for municipal waste to estimate mass-based emission factors. The mass-based emission factors are then applied to fuel loading factors based on 1996 structure fire activity to estimate emissions from residential and non-residential structure fires.

A fuel loading factor of 1.15 tons of combustible material per fire was used to estimate the structure fire activity for 1996 (Reference 2). These data were chosen to use instead of the fuel loading factor identified in the Chicago inventory because it is the most current and considered more accurate than the fuel loading factor in the Chicago inventory.

The activity data used for these estimates were the number of residential and non-residential fires that occurred in 1996 (Reference 3).

References:

1. Radian Corporation. *Development of Area Source Hazardous Air Pollutant Inventories, Volume 1: Air Toxic Emission Inventory for the Chicago Area, Draft Report*. Prepared for the EPA Air and Energy Engineering Research Laboratory. Research Triangle Park, North Carolina. July 1995. Pp. 3-59 through 3-61.
2. Emission Inventory Improvement Program. January 1999. Chapter 18: Structure Fires. External Review Draft. In: *EIIP Volume III, Area Sources Preferred and Alternative Methods*. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, EPA-454/R-97-004c. Research Triangle Park, North Carolina. July 1997. Pp. 4-4 and 4-5.
3. Federal Emergency Management Agency. *The National Fire Problem*. United States Fire Administration, Source: <http://www.usfa.fema.gov/nfdc/national.htm>.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Structure Fires

Methodology:

Calculation of Area Source Emissions Estimates for Structure Fires					
Emission Factors (Ref. 1)		Acrolein		2.55E-05 lb/dscf	
		Hydrogen Cyanide (HCN)		2.05E-04 lb/dscf	
		Formaldehyde		5.91E-06 lb/dscf	
		Hydrogen Chloride (HCL)		8.73E-05 lb/dscf	
Conversion Factors (Ref. 1)					
F-factor =		9,570 dscf/MMBtu			
HHV =		9,044 Btu/lb			
Fuel Loading Factor (Ref. 2)					
Fuel Loading =		1.15 tons material burned/fire			
Activity Data (Ref. 3)					
Total number residential fires, 1996 =		428,000			
Total number nonresidential fires, 1996 =		150,500			
Example Calculation (Ref. 1, Morikawa equation)					
Volume Gas Generated (10E-06 dscf) / Material Burned (ton) =					
= F-factor (dscf/ MMBtu) x Material burned (lb) x HHV (Btu/lb) x (MMBtu/10E6 Btu) x (2,000 lb/ton)					
= (9,570 dscf/MMBtu) x (2,000 lb/ton) x (9,044 Btu/lb) x (MMBtu/10E6Btu)					
= 173,102 dscf / ton burned					
Emission Factor (lb/ton) = EF (lb/dscf) x Volume Gas Generated (dscf/ton burned)					
= (0.0000591 lb/dscf) x (173,102 dscf/ton burned) = 1.023 lb Formaldehyde/ton burned					
Emissions Estimates					
Estimate = (Number of Fires, 1996) x Fuel Loading Factor (tons/fire) x EF (lb/ton burned)					
= 578,500 fires x (1.15 tons/fire) x (1.023 lb Formaldehyde / ton burned)					
= (680,576 lb Formaldehyde) x (2,000 lb/ton) = 340.3 tons Formaldehyde, 1996					
= 2,933,863 lb Acrolein = 1466 tons Acrolein, 1996					
= 23,610,609 lb Hydrogen Cyanide = 11,805 tons HCN, 1996					
= 10,052,305 lb Hydrogen Chloride = 5,026 tons HCL, 1996					

Methodology:**Surface Coatings: Architectural**

Emissions from architectural surface coatings are those emitted from the application of coating such as paint, primer, varnish, or lacquer to architectural surfaces and the use of solvents as thinners and for cleanup (Reference 1).

The 1996 emissions were estimated for twelve pollutants using per capita usage factors estimated from the quantity of architectural coatings shipped in 1996 for solvent-based and water-based coatings (Reference 2) and multiplying this times paint content speciation factors (Reference 3).

Emissions from solvent-based coatings and water-based coatings were estimated separately and added together to result in total emissions from the use of solvent-based and water-based architectural surface coatings.

Manufacturers and importers of architectural surface coatings will be required to limit the VOC content of each individual type of architectural surface coating material manufactured for use in the United States after September 13, 1999 (Reference 4).

References:

1. U.S. Bureau of the Census. *The Current Industrial Report for Paint, Varnish, and Lacquer (MA28F)* - 1996. Department of Commerce. Issued 1997. Pp. 2 and 3.
2. U.S. Bureau of the Census. Estimates of the Population of Counties: Annual Time Series, July 1, 1990 to July 1, 1997 (includes revised April 1, 1990 census population counts). (CO-97-4) Source: Population Estimates Program, Population Division. Washington, D.C.
3. Emission Inventory Improvement Program. November 1995. Chapter 3: Architectural Surface Coating. In: *EIIP Volume III: Area Sources Preferred and Alternative Methods*. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, EPA-454/R-97-004c. Research Triangle Park, North Carolina. July 1997.
4. *Federal Register* 63 FR 48848. National Volatile Organic Compound Emission Standards for Architectural Coatings. Final Rule. September 11, 1998.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Surface Coatings: Architectural

Methodology:

Calculation of Area Source Emission Estimates for Architectural Surface Coatings						
Activity (Ref. 1, pg. 2&3)		Solvent-Based (SB) Coatings		Water-Based (WB) Coatings		
	Exterior Coatings	67,222,000	gal/yr	Exterior Coatings	163,085,000	gal/yr
	Interior Coatings	57,948,000	gal/yr	Interior Coatings	326,940,000	gal/yr
	Total Solvent-Based =	125,170,000	gal/yr	Total Water-Based =	490,025,000	gal/yr
	1996 U.S. Population:	265,179,411	people (Ref. 2)			
Usage Factor:	Usage Factor = National Volume of Solvent, by type / U.S. Population					
	Solvent-Based-Coatings:		0.472	gal/person/year		
	Water-Based-Coatings:		1.848	gal/person/year		
VOC Emission Factors (Ref. 3)						
	Solvent-based-coatings:		3.87	lb/gal VOC		
	Water-based-coatings:		0.74	lb/gal VOC		
Emission Factor:						
	Emission Factor = VOC content * HAP Weight Fraction					
Example Calculation for Ethylene Glycol						
Solvent-Based Coatings:						
Speciated VOC Emission Factors = (3.87 lb VOC/gal SB Coatings) x (Weight Fraction VOC, SB coatings)						
	= (3.87 lb VOC / gal SB Coatings) x (0.006) = 0.0232 lb ethylene glycol/gal SB coatings					
(265,179,411 people) x (0.472 gal SB/person/yr) x (0.0232 lb/gal SB coatings) = 2,906,447 lb ethylene glycol, SB coatings						
Water-Based Coatings:						
Speciated VOC Emission Factors = (0.74 lb VOC/ gal WB Coatings) x (Weight Fraction VOC, WB coatings)						
	= (0.74 lb VOC/gal WB Coatings) x (0.005) = 0.0037 lb ethylene glycol/gal WB coatings					
(265,179,411 people) x (1.848 gal WB/person/yr) x (0.0037 lb/gal WB coatings) = 1,813,093 lb ethylene glycol, WB coatings						
Total Emissions = ethylene glycol from SB coatings (lb/year) + ethylene glycol from WB coatings (lb/yr)/2000 lb/ton						
(2,906,447 lb + 1,813,093 lb)/2,000 lb/ton = 2359.77 tons ethylene glycol, from SB and WB architectural surface coatings						
VOC Speciation Factors (Ref. 3)						
HAPS -		Weight Fraction	SB Coatings EF	HAPS	Weight Fraction	WB Coatings EF
SB Coatings		SB Coatings	(lb/gal)	WB Coatings	WB Coatings	(lb/gal)
Dimethyl Formamide		0.005	0.01935	Benzene	0.003	0.00222
Ethylbenzene		0.043	0.16641	Dichloromethane	0.055	0.0407
Ethylene Glycol		0.006	0.02322	Ethyl Chloride	0.006	0.00444
n-Hexane		0.207	0.80109	Ethylene Glycol	0.005	0.0037
Isomers of Xylene		0.026	0.10062	Methyl Chloride	0.005	0.0037
Methyl Ethyl Ketone		0.056	0.21672			
Methyl Isobutyl Ketone		0.006	0.02322			
Toluene		0.052	0.20124			
Calculation of Emission Estimates						
HAP		Solvent-Based Emissions (lb/yr)	Water-Based Emissions (lb/yr)	Total Emissions (lb/yr)	Total Emissions (ton/yr)	
Benzene		0	1087855.5	1087855.5	543.928	
Dimethyl Formamide		2422039.5	0	2422039.5	1211.020	
Ethyl Chloride		0	2175711	2175711	1087.856	
Ethylbenzene		20829539.7	0	20829539.7	10414.770	
Ethylene Glycol		2906447.4	1813092.5	4719539.9	2359.770	
n-Hexane		100272435.3	0	100272435.3	50136.218	
Methyl Chloride		0	1813092.5	1813092.5	906.546	
Methyl Ethyl Ketone		27126842.4	0	27126842.4	13563.421	
Methyl Isobutyl Ketone		2906447.4	0	2906447.4	1453.224	
Methylene Chloride		0	19944017.5	19944017.5	9972.009	
Toluene		25189210.8	0	25189210.8	12594.605	
Xylenes		12594605.4	0	12594605.4	6297.303	

Methodology:

Surface Coatings: Traffic Markings

The 1996 emissions were estimated for thirteen pollutants by multiplying VOC emission factors times national (traffic paint) usage in 1996 (Reference 1).

Individual VOC emission factors were developed from data provided by the EPA in the Emission Inventory Improvement Program Guidance for estimating emissions from Traffic Markings (Reference 2).

References:

1. U.S. Bureau of the Census. *Current Industrial Reports. Paint, Varnish, and Lacquer (MA28F) - 1996*. U.S. Department of Commerce. Source: <http://www.census.gov/industry/ma28f96.txt>. Issued August 1997. Table 2.
2. Emission Inventory Improvement Program. May 1997. Chapter 14: Traffic Markings. In: *EIIP Volume III: Area Sources Preferred and Alternative Methods*. U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards, EPA-454/R-97-004c. Research Triangle Park, North Carolina. July 1997. Pp. 4-4 and 4-12.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Surface Coatings: Traffic Markings

Methodology:

Calculation of Area Source Emission Estimates for Traffic Markings

Activity:

National Traffic Paint Usage for 1996: 36,944,000 gal/yr (Ref. 1)

Emission Factor: 3.36 lb VOC/gal paint (Ref. 2)

Example Calculation:

Speciated VOC Emission Factors = (3.36 lb VOC/gal) x (Volume Percent of VOC)

= (3.36 lb VOC/gal) x 0.009/100 = .000302 lb Carbon Tet./gal paint

Emissions = (36,944,000 gal paint, 1996) x (0.000302 lb Carbon Tet./gal paint)

(11,171 lb Carbon Tet.) x (1 ton/2,000 lb) = 5.585 tons Carbon Tet.

VOC Speciation Factors			
HAP	Volume Percent (%) (Ref. 2)		
Carbon tetrachloride	0.009		
Cumene	0.002		
Ethylbenzene	0.009		
Ethylene glycol	0.086		
Glycol ethers	0.04		
Methyl ethyl ketone	1.514		
Methyl isobutyl ketone	0.002		
Methyl methacrylate	0.044		
Napthalene	0.002		
Propylene oxide	0.115		
Styrene	0.277		
Toluene	6.914		
Xylenes (mixed isomers)	0.499		

Calculation of Emission Estimates			
HAP	Emission Factor (lb/gal)	Total Emissions (lb/yr)	Total Emissions (ton/yr)
Carbon tetrachloride	0.0003024	11171.9	5.586
Cumene	0.0000672	2482.6	1.241
Ethylbenzene	0.0003024	11171.9	5.586
Ethylene glycol	0.0028896	106753.4	53.377
Glycol ethers	0.001344	49652.7	24.826
Methyl ethyl ketone	0.0508704	1879356.1	939.678
Methyl isobutyl ketone	0.0000672	2482.6	1.241
Methyl methacrylate	0.0014784	54618.0	27.309
Napthalene	0.0000672	2482.6	1.241
Propylene oxide	0.003864	142751.6	71.376
Styrene	0.0093072	343845.2	171.923
Toluene	0.2323104	8582475.4	4291.238
Xylenes (mixed isomers)	0.0167664	619417.9	309.709

Methodology:

Industrial Maintenance Coatings

Industrial maintenance coatings are high performance architectural coatings, including primers, sealers, undercoaters, intermediate coats, and topcoats formulated and recommended for application to substrates exposed to extreme environmental conditions in industrial, commercial, or institutional settings.

The 1996 emissions from the use of industrial maintenance coatings were estimated for thirteen pollutants by multiplying emission factors developed from 1990 data provided by the California Air Resources Board (CARB) (References 1 and 3) and 1996 coating sales data (Reference 2).

Refer to the next page for emissions estimation procedure and calculations.

References:

1. California Environmental Protection Agency. *Survey of Emissions from Solvent Use, Volume II: Architectural Coatings. Final Report.* Air Resources Board Research Division. September 1994. Pp. 27, 28.
2. United States Department of Commerce. *The Current Industrial Report for Paint, Varnish, and Lacquer (MA28F) - 1996.* Bureau of the Census. Issued 1997. Table 2, P. 4
3. California Environmental Protection Agency. *Improvement of Speciation Profiles for Architectural and Industrial Maintenance Operations. Final Report.* Air Resources Board Research Division. June 1996. Pp.90, 138 - 140.

APPENDIX A: NATIONAL AREA SOURCE ESTIMATES - Surface Coatings: Industrial Maintenance

Methodology:

Industrial Maintenance Coatings (IMC) Emissions Estimation Procedure										
Step 1) Estimated emission factors (lb VOC/gallon) for Water-based Coatings (WBC) and Solvent-based Coatings (SBC) using data from the 1994 CARB solvent use survey report (Ref. 1). EF = 1990 emissions / 1990 coating sales										
= 1990 emissions (tpy) x (2000 lb/ton) / (1000 gal coatings) = lb VOC /gal										
Coating Category		1990 Coating Sales in CA (Ref. 1)		% Sold, By Type Coating		1990 VOC Emissions in CA (Ref. 1)		New VOC Emission Factors		
		WBC (1000 gal)	SBC (1000 gal)	WBC	SBC	WBC (tons/year)	SBC (tons/year)	WBC (lb/gal)	SBC (lb/gal)	
Industrial Maintenance Coatings		241	2837	7.8	92.2	97	4418	0.80	3.11	
1996 activity is the amount of industrial new construction and maintenance paints shipped within the US in 1996. (Ref. 2).										
Interior = 23035000		gallons								
Exterior = 49541000		gallons								
72576000		gallons								
Step 2) Multiply emission factors from step 1 by the amount of both WBC and SBC shipped in 1996.										
(0.80 lb VOC/gal WBC) x 72,576,000 gallons x 0.078 (% WBC) = 4,528,742 lb VOC/year from WBC										
= 2264.37 tpy VOC from WBC										
(3.11 lb VOC/gal SBC) x 72,576,000 gallons x 0.922 (% SBC) = 208,105,874 lb VOC/year from SBC										
= 104,052.94 tpy VOC from SBC										
Step 3) Multiply the WBC and SBC emissions of VOC by the percent contribution of each HAP identified in the 1996 CARB speciation report. (Ref. 3).										
Example calculation using ethylene glycol										
(4,528,742 lb VOC/year, WBC) x 0.1271 = 575,603 lb ethylene glycol / year from Water-based Coatings										
= 287.80 tons per year Ethylene Glycol from Water-based Coatings										
(208,105,874 lb VOC/year, SBC) x 0.0048 = 998,908 lb ethylene glycol / year from Solvent-based Coatings										
= 499.454 tons per year ethylene glycol from Water-based Coatings										
				Water-based Coatings Average VOC Weight Fraction (Ref 3, pg. 90)		Solvent-based Coatings VOC Weight Fraction (Ref. 3, pg. 138-140)		Emissions from WBC tons/year	Emissions from SBC tons/year	Total Emissions tons/year
HAP (POLLNAME)		POLLID								
Acetophenone		80		not identified		0.0006			62.432	62.432
Cumene		108		not identified		0.0012			124.864	124.864
Dibutyl Phthalate		112		0.0031		not identified		7.020		7.020
Ethylbenzene		122		not identified		0.0062			645.128	645.128
Ethylene Glycol		123		0.1271		0.0048		287.802	499.454	787.256
Glycol Ethers		43		0.1434		0.0334		324.711	3475.368	3800.079
Isophorone		138		not identified		0.0053			551.481	551.481
Methanol		140		0.0429		0.0151		97.142	1571.199	1668.341
Methyl Ethyl Ketone		144		not identified		0.0065			676.344	676.344
Methyl Isobutyl Ketone		146		not identified		0.0162			1685.658	1685.658
Naphthalene		3111		not identified		0.0022			228.916	228.916
Toluene		45		not identified		0.0118			1227.825	1227.825
Xylenes -o,-m,-p		47		not identified		0.0348			3621.042	3621.042
Step 4) Add emissions from Water-based and Solvent-based Coatings by Pollutant										
287.802 tpy ethylene glycol, WBC + 499.454 tpy ethylene glycol, SBC = 787.256 tpy ethylene glycol from IMC										
References										
1. California Environmental Protection Agency. "Survey of Emissions from Solvent Use, Volume II: Architectural Coatings." Final Report. Air Resources Board Research Division. September 1994. Pp 27-28.										
2. United States Department of Commerce. The Current Industrial Report for Paint, Varnish, and Lacquer (MA28F) - 1996. Bureau of the Census. Issued 1997. Table 2, p. 4.										
3. California Environmental Protection Agency. "Improvement of Speciation Profiles for Architectural and Industrial Maintenance Operations". Final Report. Air Resources Board Research Division. June 1996. Pp. 90, 138-140.										

Appendix B

MACT Source Categories in the 1996 Area Source NTI

Table B-1**MACT Source Categories Included In The 1996 NTI Area Source Inventory**

MACT Category Name	Base Year^a	Reference	Notes^b
Acrylic Fibers/Modacrylic Fibers Production	1997	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Aerospace Industries	1996	Facility list from ESD; Emissions from TRI.	ESD provided a list of applicable SIC codes. The list was then used to identify facilities in TRI. The applicable SIC codes are: 3721, 3724, 3728, 3761, 3764, 3769.
Amino/Phenolic Resins Production	1992	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Animal Cremation	1996	National activity data from ESD; Emission factors from CARB and USEPA FIRE database	National estimates were developed by multiplying national activity data by the corresponding emission factors. National activity data provided by ESD for 1990 were scaled up to 1996 using population data.
Asphalt Concrete Manufacturing	1996	National estimates from ESD.	National estimates provided by ESD were multiplied by the percent of area sources (100%) and allocated to counties based on employment within SIC code 2951.
Asphalt Roofing Manufacturing	1996	National estimates from ESD.	National estimates provided by ESD were multiplied by the percent of area sources (15%) and allocated to counties based on employment within SIC code 2952.
Boat Manufacturing	1996	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Cellulose Ethers Production	1996	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.

Table B-1**MACT Source Categories Included In The 1996 NTI Area Source Inventory (Continued)**

MACT Category Name	Base Year^a	Reference	Notes^b
Chromic Acid Anodizing	1990	National estimates from ESD in 58 FR 65768.	National estimates were multiplied by the percent of area sources (95%) and allocated to counties based on employment within SIC code 3471.
Commercial Sterilization Facilities	1996	Facility list developed from a list of SIC codes and zip codes provided by ESD; emissions from TRI.	A facility list was developed. The list was used to identify facilities listed in TRI. Only ethylene oxide emissions from TRI were identified as subject to MACT.
Cyanide Chemicals Manufacturing	1996	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Decorative Chromium Electroplating	1990	National 1990 emission estimates have been adjusted to 1996 levels. Estimates reflect the implementation of the applicable standard from ESD in 58 FR 65768.	Emissions are assumed to be negligible after implementing the applicable standard in 1996.
Dry Cleaning (Petroleum Solvent)	1998	National estimates from ESD.	National estimates provided by ESD (100% area) were allocated to counties based on employment within SIC codes 7215, 7216, and 7218.

Table B-1

MACT Source Categories Included In The 1996 NTI Area Source Inventory (Continued)

MACT Category Name	Base Year^a	Reference	Notes^b
Flexible Polyurethane Foam Fabrication Operations	1993	National estimates provided by ESD for the draft MACT baseline inventory.	National estimates were provided by ESD under previous inventory effort. These estimates were multiplied by the percent area source (7%) and allocated to counties based on employment within the SIC code 3086.
Flexible Polyurethane Foam Production	1993	Facility list from ESD; national estimates provided by ESD for the draft MACT baseline inventory.	National estimates provided by ESD under previous inventory effort were multiplied by the percent of area sources (75%) and allocated to counties. A facility list from ESD was used to identify the counties to which emissions must be allocated.
Friction Products	1997	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Fumed Silica Production	1996	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Gasoline Distribution (Stage 1)	1998	National estimates provided by ESD for the draft MACT baseline inventory.	National estimates were provided by ESD under previous inventory effort. These estimates were multiplied by the percent of area sources (95%) and allocated to counties based on employment within the SIC code 5171.

Table B-1

MACT Source Categories Included In The 1996 NTI Area Source Inventory (Continued)

MACT Category Name	Base Year^a	Reference	Notes^b
Halogenated Solvent Cleaners	1994	National estimates from ESD.	Unspeciated national estimates provided by ESD were equally divided among a list of applicable HAPs also provided by ESD. HAPs to be phased out by January 1, 1996 according to the Montreal Protocol were not included. These are 1,1,1 trichloroethane and carbon tetrachloride. The area source component (30 percent) was then allocated to counties based on employment within SIC Group COMMIND.
Hard Chromium Electroplating	1990	National estimates from ESD in 58 FR 65768.	National estimates were multiplied by the percent of area sources (95%) and allocated to counties based on employment within SIC code 3471.
Hazardous Waste Incineration	1997	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Human Cremation	1996	National activity data from ESD; Emission factors from CARB and USEPA FIRE database	National estimate were developed by multiplying national activity data by the corresponding emission factors. National activity data were provided by ESD and the Cremation Association of North America.
Hydrochloric Acid Production	1996	Facility list from ESD, emissions from TRI.	A facility list was provided by ESD under previous inventory effort. The list was used to identify facilities in TRI.
Hydrogen Fluoride Production	1996	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.

Table B-1

MACT Source Categories Included In The 1996 NTI Area Source Inventory (Continued)

MACT Category Name	Base Year^a	Reference	Notes^b
Industrial Boilers - Natural Gas	1994	National estimates from ESD.	National estimates were multiplied by the percent of area sources (30%) and allocated to counties based on employment within SIC Group IND.
Industrial Boilers: Coal, all types	1994	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD
Industrial Boilers: Waste Oil	1994	National estimates from ESD.	National estimates were multiplied by the percent of area sources (30%) and allocated to counties based on employment within SIC Group IND.
Industrial Boilers: Wood/Wood Residue	1994	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Industrial Boilers: Distillate Oil	1994	National estimates from ESD.	National estimates were multiplied by the percent of area sources (30%) and allocated to counties based on employment within SIC Group IND.
Industrial Boilers: Residual Oil	1994	National estimates from ESD.	National estimates were multiplied by the percent of area sources (30%) and allocated to counties based on employment within SIC Group IND.
Institutional/Commercial Heating: Anthracite Coal	1995	National estimates from ESD.	An independent Industrial Combustion Coordinated Rule (ICCR) facility list from ESD was used to identify counties to which emissions were allocated. The allocation was based on employment within SIC Group COMM.
Institutional/Commercial Heating: Bituminous and Lignite Coal	1995	National estimates from ESD.	An independent ICCR facility list from ESD was used to identify counties to which emissions were allocated. The allocation was based on employment within SIC Group COMM.

Table B-1

MACT Source Categories Included In The 1996 NTI Area Source Inventory (Continued)

MACT Category Name	Base Year^a	Reference	Notes^b
Institutional/Commercial Heating: Distillate Oil	1995	National estimates from ESD.	ESD indicated a 100% area source component. Emissions were allocated to counties based on employment within SIC Group COMM.
Institutional/Commercial Heating: Natural Gas	1995	National estimates from ESD.	ESD indicated a 100% area source component. Emissions were allocated to counties based on employment within SIC Group COMM.
Institutional/Commercial Heating: POTW Digester Gas	1996	National estimates from ESD.	An independent ICCR facility list from ESD was used to identify counties to which emissions were allocated. The allocation was based on employment within SIC Group COMM.
Institutional/Commercial Heating: Residual Oil	1995	National estimates from ESD.	ESD indicated a 100% area source component. Emissions were allocated to counties based on employment within SIC Group COMM.
Institutional/Commercial Heating: Wood/Wood Residue	1996	National estimates from ESD.	An independent ICCR facility list from ESD was used to identify counties to which emissions were allocated. The allocation was based on the regional proportion of wood consumption and employment within SIC Group COMM.
Leather Tanning and Finishing Operations	1996	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Lime Manufacturing	1996	Facility-level emissions from TRI.	TRI facilities listed under SIC code 3274.
Metal Can (Surface Coating)	1997	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.

Table B-1

MACT Source Categories Included In The 1996 NTI Area Source Inventory (Continued)

MACT Category Name	Base Year^a	Reference	Notes^b
Mineral Wool Manufacturing	1994	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Municipal Landfills	1996	Facility-specific emissions from ESD	Facility-specific emissions provided by ESD.
Municipal Waste Combustors	1996	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Natural Gas Transmissions and Storage	1998	National estimates from ESD.	National estimates were multiplied by the percent of area sources (80%) and allocated to counties based on employment within SIC code 4923.
Oil and Natural Gas Production	1993	National estimates from ESD.	National estimates were multiplied by the percent of area sources (35%) and allocated to counties based on employment within SIC code 1310.
Paint Stripping Operations	1998	National estimates from ESD.	National estimates were multiplied by the percent of area sources (90%) and allocated to counties based on the county proportion of national population.
Paper and Other Webs (Surface Coating)	1996	List of applicable SIC codes from ESD; Emissions from TRI.	A list of applicable SIC codes was provided by ESD. The list of SIC codes was used to identify facilities in TRI. The applicable SIC codes are: 2653, 2657, 2672, 2677, 2679, 3083, 3291, 3955.
Perchloroethylene Dry Cleaning	1996	National estimates from ESD.	National estimates provided by ESD (100% area) were allocated to counties based on employment within SIC codes 7215, 7216, and 7218.
Pharmaceuticals Production	1990/92	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD

Table B-1

MACT Source Categories Included In The 1996 NTI Area Source Inventory (Continued)

MACT Category Name	Base Year^a	Reference	Notes^b
Plastic Parts and Products (Surface Coating)	1996	List of applicable SIC codes provided by ESD for the draft MACT baseline inventory; emissions from TRI.	A list of applicable SIC codes was provided by ESD under previous inventory effort. The list was used to identify facilities in TRI. The applicable SIC codes are: 3089, 3573, 3571, 3577, 3578, 3579, 3643, 3647, 3711, 3713, 3714, 3715, 3716, 3799, 3821, 3931, 3944, 3949, 3993.
Plywood and Composite Wood Products	1996	Facility list provided by ESD for the draft MACT baseline inventory; emissions from TRI.	A facility list was provided by ESD under previous inventory effort. The list was used to identify facilities listed in TRI.
Polysulfide Rubber Production	1991	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Polyvinyl Chloride and Copolymers Production	1990	National estimate from the draft MACT baseline inventory.	National estimates developed as part of the MACT Baseline inventory were multiplied by the percent of area sources (5.5%) and allocated to counties based on employment within SIC code 2821.
Primary Aluminum Production	1996	Facility-level emissions from TRI.	TRI facilities listed under SIC code 3334.
Printing, Coating, and Dyeing of Fabrics	1996	List of applicable SIC codes from ESD; emissions from TRI.	A list of applicable SIC codes was provided by ESD under previous inventory effort. The list of SIC codes was used to identify facilities in TRI. The applicable SIC codes are: 2211, 2221, 2231, 2251, 2252, 2258, 2259, 2261, 2262, 2269, 2273, 2281, 2282, 2297, 2299.

Table B-1

MACT Source Categories Included In The 1996 NTI Area Source Inventory (Continued)

MACT Category Name	Base Year^a	Reference	Notes^b
Printing/Publishing (Surface Coating)	1996	List of applicable SIC codes provided by ESD for the 1990 MACT Baseline inventory; emissions from TRI.	A list of applicable SIC codes was provided by ESD under previous inventory effort. The list of SIC codes was used to identify facilities in TRI. The applicable SIC codes are: 2295, 2649, 2671, 2673, 2674, 2676, 2721, 2754, 2759, 3497, 3996.
Publicly Owned Treatment Works (POTW) Emissions	1996	National estimates from ESD.	National estimates were allocated to counties based on population.
Refractories Manufacturing	1996	Facility list from ESD; national estimates from ESD	National estimates were allocated to the list of facilities provided by ESD. All facilities listed by ESD were assumed to be area sources.
Reinforced Plastic Composites Production	1996	Facility-level emissions from TRI.	Facility-specific emissions from TRI.
Secondary Lead Smelting	1996	Facility list from ESD; Emissions from TRI.	A facility list was provided by ESD under previous inventory effort. The list was used to identify facilities in TRI.
Stationary Internal Combustion Engines - Diesel	1996	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Stationary Internal Combustion Engines - Natural Gas	1996	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.

Table B-1

MACT Source Categories Included In The 1996 NTI Area Source Inventory (Continued)

MACT Category Name	Base Year^a	Reference	Notes^b
Stationary Turbines	1996	Facility-level emissions from ESD.	Facility-specific emissions provided by ESD.
Steel Pickling HCl Process	1991	National estimates from ESD in 62 FR 49054.	National estimates provided by ESD under previous inventory effort were multiplied by the percent of area sources(10%) and allocated to counties based on employment within SIC code 3312.
Taconite Iron Ore Processing	1989	National estimate developed as part of the draft MACT baseline inventory.	National estimates developed as part of the 1990 MACT Baseline inventory were multiplied by the percent of area sources (50%) and allocated to counties based on employment within SIC code 1010.

^a For some source categories, the necessary activity or emissions data were not available to compile 1996 estimates.

^b SIC Groups COMM, COMMIND, and IND used in the allocation schemes are defined in Table E-3 of Appendix E.

Appendix C

TRI Source Categories in the 1996 Area Source NTI

Industry Group	SIC Code	SIC Code Description
Oil and Gas Extraction	1311	Crude Petroleum and Natural Gas
Mining and quarrying of nonmetallic minerals, except fuels	1446	Industrial Sand
Food and Kindred Products	2011	Meat Packing Plants
	2013	Sausages And Other Prepared Meats
	2015	Poultry Slaughtering and Processing
	2016	Poultry Dressing Plants
	2020	Dairy Products
	2022	Cheese, Natural and Processed
	2023	Condensed and Evaporated milk
	2033	Canned Fruits and Vegetables
	2034	Dehydrated Fruits, Vegetables, and Soups
	2035	Pickles, Sauces, And Salad Dressings
	2037	Frozen fruits, Fruit Juices and Vegetables
	2038	Frozen Specialties, nec
	2041	Flour and Other Grain Mill Products
	2043	Cereal Breakfast Foods
	2044	Rice Milling
	2045	Prepared Flour Mixes And Doughs
	2046	Wet Corn Milling
	2047	Dog and Cat Food
	2048	Prepared Feeds Manufacturing
	2061	Raw Cane Sugar
	2062	Cane Sugar Refining
	2063	Beet Sugar
	2066	Chocolate And Cocoa Products
	2077	Animal And Marine Fats And Oils
	2079	Edible Fats and Oils, nec
	2082	Malt Beverages
	2083	Malt
	2085	Distilled and Blended Liquors Production
	2086	Bottled and Canned Soft Drinks
	2087	Flavoring Extracts and Syrups Production
	2090	Miscellaneous Foods and Kindred Products
	2095	Roasted Coffee
	2098	Macaroni And Spaghetti
	2099	Food Preparations Production
Tobacco Products	2111	Cigarettes
Textile Mill Products	2296	Tire Cord and Fabric
Apparel and Other Finished Products Made from Fabrics and Similar Materials	2321	Men's and Boys' Shirts
	2337	Women's, Misses', and Juniors' Suits, Skirts, and Coats

Industry Group	SIC Code	SIC Code Description
Apparel and Other Finished Products Made from Fabrics and Similar Materials (Continued)	2353	Hats, Caps, And Millinery
	2389	Apparel and Accessories, nec
	2396	Automotive and Apparel Trimmings
	2399	Fabricated Textile Products, nec
Lumber and Wood Products, Except Furniture	2421	Sawmills and Planing Mills, general
	2426	Hardwood Dimension and Flooring Mills
	2430	Millwork, Plywood, and Structural Members
	2431	Millwork
	2434	Wood Kitchen Cabinets
	2435	Hardwood Veneer and Plywood
	2436	Softwood Veneer and Plywood
	2439	Structural Wood Members, nec
	2451	Mobile Homes
	2452	Prefabricated Wood Buildings and Components
	2491	Wood Preserving
	2493	Reconstituted Wood Products
	2499	Wood Products
Furniture and Fixtures	2511	Wood Household Furniture Manufacturing
	2512	Upholstered Household Furniture
	2514	Metal Household Furniture
	2517	Wood Television and Radio Cabinets
	2519	Household Furniture
	2521	Wood Office Furniture
	2522	Office Furniture, Except Wood Manufacturing
	2531	Public Building and Related Furniture
	2541	Wood Partitions and Fixtures
	2542	Partitions and Fixtures, Except Wood
	2591	Drapery Hardware and Blinds and Shades
	2599	Furniture and Fixtures Manufacturing
Paper and Allied Products	2611	Pulp mills (2611)
	2621	Paper Mills
	2631	Paperboard Mills
	2641	Paper Coating and Glazing Manufacturing
	2655	Fiber Cans, Drums, and Similar Products
	2656	Sanitary Food Containers
	2661	Building Paper and Building Board Mills
Printing, Publishing, and Allied Industries	2732	Book Printing
	2751	Commercial Printing, Letterpress, and Screen
	2752	Commercial Printing, Lithographic
	2782	Blankbooks and Looseleaf Binders
	2789	Bookbinding And Related Work

Industry Group	SIC Code	SIC Code Description
Printing, Publishing, and Allied Industries (Continued)	2796	Platemaking Services
Chemicals and Allied Products	2800	Chemicals and Allied Products Manufacturing
	2812	Chemical Manufacturing: Alkalies and Chlorine
	2813	Industrial Gases Manufacturing
	2816	Inorganic Pigments Manufacturing
	2819	Industrial Inorganic Chemical Manufacturing
	2822	Synthetic Rubber Manufacturing
	2824	Organic Fibers, Non-cellulosic Manufacturing
	2831	Biological Products
	2833	Medicinals and Botanicals Manufacturing
	2834	Pharmaceutical Preparations Manufacturing
	2835	Diagnostic Substances
	2836	Biological Products, Except Diagnostic
	2840	Soaps, Cleaners, and Toilet Goods
	2841	Soap and Other Detergents Manufacturing
	2842	Polishes and Sanitation Goods Manufacturing
	2843	Surface Active Agents Manufacturing
	2844	Toilet Preparations Manufacturing
	2850	Paints, Coatings, and Adhesives
	2851	Paints and Allied Products Manufacturing
	2861	Gum and Wood Chemical Manufacturing
	2865	Chemical Manufacturing: Cyclic Crude and Intermediate Production
	2869	Industrial Organic Chemicals Manufacturing
	2873	Nitrogenous Fertilizers
	2874	Phosphatic Fertilizers
	2875	Fertilizers, Mixing only
	2879	Agricultural Chemicals and Pesticides
	2891	Adhesives and Sealants
	2892	Chemical Manufacturing: Explosives & Blasting Agents
	2893	Printing Ink
	2895	Carbon Black
	2899	Chemical Preparations
Petroleum Refining and Related Industries	2911	Petroleum Refining
	2992	Lubricating Oils and Greases
	2999	Petroleum Refining: Other Petroleum Products
Rubber and Miscellaneous Plastics Products	3011	Tires and Inner Tubes
	3021	Rubber and Plastic Footwear
	3050	Hose and Belting and Gaskets and Packing
	3052	Rubber and Plastic Hose and Belting Manufacturing

Industry Group	SIC Code	SIC Code Description
Rubber and Miscellaneous Plastics Products (Continued)	3053	Gaskets, Packing and Sealing Devices Manufacturing
	3061	Mechanical Rubber Goods Manufacturing
	3069	Fabricated Rubber Products, nec
	3079	Miscellaneous Plastics Products
	3081	Unsupported Plastics Film & Sheet
	3082	Unsupported Plastics Profile Shapes
	3085	Plastics Products Inc. Plastic Bottles
	3087	Custom Compound Purchased Resins Manufacturing
	3088	Plastics Plumbing Fixtures
Leather and Leather Products	3111	Leather Tanning and Finishing
	3131	Footwear Cut Stock
	3143	Men's Footwear, Except Athletic
	3144	Women's Footwear, Except Athletic
	3149	Footwear, Except Rubber, nec
Stone, Clay, Glass, and Concrete Products	3211	Flat Glass
	3221	Glass Containers
	3229	Pressed and Blown Glass and Glassware Manufacturing
	3231	Products of Purchased Glass
	3241	Cement, Hydraulic (not subject to Portland Cement Regulation)
	3251	Brick and Structural Clay Tile
	3253	Ceramic Wall and Floor Tile Manufacturing
	3255	Clay Refractories
	3261	Vitreous Plumbing Fixtures
	3262	Vitreous China Table and Kitchenware
	3264	Porcelain Electrical Supplies
	3269	Pottery Products, nec
	3270	Concrete, Gypsum, And Plaster Products
	3271	Concrete Block and Brick
	3272	Concrete Products
	3275	Gypsum Products
	3281	Cut Stone and Stone Products
	3292	Asbestos Products Manufacturing
	3295	Minerals, Ground or Treated Production
	3296	Mineral Wool
	3297	Nonclay Refractories
	3299	Nonmetallic Mineral Products Manufacturing
Primary Metal Industries	3313	Electrometallurgical Products Manufacturing
	3315	Steel Wire and Related Products Manufacturing
	3316	Cold Finishing of Steel Shapes

Industry Group	SIC Code	SIC Code Description
Primary Metal Industries (Continued)	3317	Steel Pipe and Tubes Manufacturing
	3321	Gray and Ductile Iron Foundries
	3322	Malleable Iron Foundries
	3324	Iron and Steel Foundries: Steel Investment Foundries
	3325	Iron and Steel Foundries: Steel Foundries
	3339	Primary Nonferrous Metals Production
	3341	Secondary Nonferrous Metals Production
	3351	Copper Rolling and Drawing
	3353	Aluminum Sheet, Plate, and Foil manufacturing
	3354	Aluminum Extruded Products
	3355	Aluminum Rolling and Drawing, nec
	3356	Nonferrous Rolling and Drawing
	3357	Nonferrous Wire Drawing and Insulating
	3361	Aluminum Foundries (Castings)
	3362	Brass, Bronze, Copper, Copper Base Alloy Foundries
	3363	Aluminum Die-Castings
	3364	Nonferrous Die-castings, Except Aluminum
	3365	Aluminum Foundries
	3366	Copper Foundries
	3369	Nonferrous Foundries, nec
	3390	Miscellaneous Primary Metal Products Manufacturing
	3398	Metal Heat Treating Manufacturing
	3399	Primary Metal Products Manufacturing
Fabricated Metal Products, Except Machinery and Transportation Equipment	3400	Fabricated Metal Products Manufacturing
	3411	Metal cans (3411)
	3412	Metal Barrels, Drums, and Pails Manufacturing
	3421	Cutlery
	3423	Hand and Edge Tools Manufacturing
	3425	Saw Blades and Handsaws
	3429	Hardware Manufacturing
	3431	Metal Sanitary Ware Manufacturing
	3432	Plumbing Fixture Fittings and Trim
	3433	Heating Equipment, Except Electric
	3440	Fabricated Structural Metal Products
	3441	Fabricated Structural Metal Manufacturing
	3442	Metal Doors, Sash, and Trim
	3443	Fabricated Plate Work (Boiler Shops)
	3444	Sheet Metal Work
	3446	Architectural Metal Work

Industry Group	SIC Code	SIC Code Description
Fabricated Metal Products, Except Machinery and Transportation Equipment (Continued)	3448	Prefabricated Metal Buildings
	3449	Miscellaneous Metal Work
	3451	Screw Machine Products Manufacturing
	3452	Bolts, Nuts, Rivets and Washers Manufacturing
	3460	Metal Forgings and Stampings
	3462	Iron and Steel Forging
	3463	Nonferrous Forgings
	3465	Automotive Stampings
	3469	Metal Stampings Manufacturing
	3479	Metal coating and allied services (3479)
	3482	Small Arms Ammunition
	3483	Ammunition, Except for Small Arms
	3484	Small Arms
	3489	Ordnance and Accessories Manufacturing
	3490	Miscellaneous Fabricated Metal Products
	3491	Metal Valves
	3492	Fluid power Valves and Hose Fittings Manufacturing
	3493	Steel Springs, Except Wire
	3494	Valves and Pipe Fittings Manufacturing
	3495	Wire Springs
	3496	Miscellaneous Fabricated Wire Products
	3498	Fabricated Pipe and Fittings
	3499	Fabricated Metal Products, nec
Industrial and Commercial Machinery and Computer Equipment	3511	Turbines and Turbine Generator Sets
	3519	Internal Combustion Engine Manufacturing
	3523	Farm Machinery and Equipment Manufacturing
	3524	Lawn and Garden Equipment
	3531	Construction Machinery Manufacturing
	3532	Mining Machinery Manufacturing
	3533	Oil and Gas Field Machinery Manufacturing
	3534	Elevators and Moving Stairways Manufacturing
	3535	Conveyors and Conveying Equipment Manufacturing
	3536	Hoists, Cranes, and Monorails
	3540	Metalworking Machinery
	3541	Machine tools, Metal Cutting Types
	3542	Machine tools, Metal Forming Types
	3544	Special Dies, Tools, Jigs and Fixtures
	3545	Machine Tool Accessories
	3546	Power Driven Handtools

Industry Group	SIC Code	SIC Code Description
Industrial and Commercial Machinery and Computer Equipment (Continued)	3547	Rolling Mill Machinery
	3548	Welding Apparatus
	3549	Metalworking Machinery, nec
	3550	Special Industry Machinery Manufacturing
	3552	Textile Machinery
	3553	Woodworking Machinery
	3554	Paper Industries Machinery
	3555	Printing Trades Machinery Manufacturing
	3556	Food Products Machinery Manufacturing
	3559	Special Industry Machinery, nec
	3561	Pumps and Pumping Equipment Manufacturing
	3562	Ball and Roller Bearings Manufacturing
	3563	Air and Gas Compressors
	3564	Blowers and Fans
	3565	Industrial Patterns Packaging machinery
	3566	Speed Changers, Drives, and Gears
	3567	Industrial Furnaces and Ovens
	3568	Power Transmission Equipment
	3569	General Industrial Machinery Manufacturing
	3572	Typewriters Computer Storage Devices
	3581	Automatic Vending Machines
	3582	Commercial Laundry Equipment
	3585	Refrigeration and Heating Equipment Manufacturing
	3586	Measuring and Dispensing Pumps
	3589	Service Industry Machinery
	3592	Carburetors, Pistons, Rings and Valves Manufacturing
	3593	Fluid Power Cylinders and Activators
	3594	Fluid Power Pumps and Motors
	3596	Scales and Balances, Excluding Laboratory
	3599	Industrial Machinery, nec
Electronic and Other Electrical Equipment and Components, Except Computer Equipment	3600	Electronic & Other Electric Equipment
	3612	Transformers, Except Electronic
	3613	Switchgear and Switchboard Apparatus
	3621	Motor and Generators Manufacturing
	3622	Industrial Controls
	3624	Carbon and Graphite Products
	3625	Relays and Industrial Controls
	3629	Electrical Industrial Apparatus, nec
	3631	Household Cooking Equipment

Industry Group	SIC Code	SIC Code Description
Electronic and Other Electrical Equipment and Components, Except Computer Equipment (Continued)	3632	Household Refrigerators and Freezers
	3633	Household Laundry Equipment
	3634	Electrical Housewares and Fans
	3635	Household Vacuum Cleaners
	3639	Household Appliances Manufacturing
	3641	Electric Lamps
	3644	Noncurrent-Carrying Wiring Devices
	3645	Residential lighting fixtures
	3646	Commercial Lighting Fixtures
	3648	Lighting Equipment
	3651	Household Audio and Video Equipment
	3652	Pre-recorded Records and Tapes
	3661	Telephone and Telegraph Apparatus
	3663	Radio and Television Communications Equipment (3663)
	3669	Communications Equipment, nec
	3671	Electron Tubes Manufacturing
	3672	Cathode Ray Television Picture Tubes Manufacturing
	3674	Semiconductors and Related Devices
	3675	Electronic Capacitors Manufacturing
	3676	Electronic Resistors
	3677	Electronic Coils and Transformers
	3678	Electronic Connectors
	3679	Electronic Components, nec
	3691	Storage Batteries Manufacturing
	3692	Primary Batteries, Dry and Wet, Manufacturing
	3694	Engine Electric Equipment
	3695	Magnetic and Optical Recording Media Manufacturing
	3699	Electrical Equipment and Supplies, nec
Transportation Equipment	3731	Ship Building And Repairing
	3732	Boat Building and Repairing
	3743	Railroad Equipment Manufacturing
	3792	Travel Trailers and Campers Manufacturing
	3795	Tanks and Tank Components Manufacturing
Measuring, Analyzing, and Controlling Instruments; Photographic, Medical and Optical Goods; Watches and Clocks	3812	Search and Navigation Equipment
	3822	Environmental Controls Manufacturing
	3823	Process Control Instruments
	3824	Fluid Meters and Counting Devices

Industry Group	SIC Code	SIC Code Description
Measuring, Analyzing, and Controlling Instruments; Photographic, Medical and Optical Goods; Watches and Clocks (Continued)	3825	Instruments to Measure Electricity
	3826	Analytical Instruments
	3827	Optical Instruments and Lenses
	3829	Measuring and Controlling Devices, nec
	3841	Surgical and Medical Instruments Manufacturing
	3842	Surgical Appliances and Supplies Manufacturing
	3843	Dental Equipment and Supplies
	3844	X-ray Apparatus and Tubes
	3845	Electromedical Equipment Manufacturing
	3851	Ophthalmic Goods
	3861	Photographic Equipment and Supplies Manufacturing
Miscellaneous Manufacturing Industries	3914	Silverware and Plated Ware
	3915	Jewelers' Materials & Lapidary Work
	3940	Toys and Sporting Goods
	3951	Pens and Mechanical Pencils
	3952	Lead Pencils, Art Goods Manufacturing
	3953	Marking Devices
	3965	Fasteners, Buttons, Needles, and Pins
	3990	Miscellaneous Manufactures (3990)
	3991	Brooms and Brushes
	3995	Burial Caskets
	3999	Manufacturing Industries Manufacturing
Electric, Gas, and Sanitary Services	4941	Water Supply
	4952	Sewerage Systems
	4953	Refuse Systems
Wholesale Trade - Durable Goods	5047	Medical, Dental, and Hospital Equipment, Supplies
Wholesale Trade - Nondurable Goods	5161	Chemicals and allied products (5161)
	5169	Chemicals and Allied Products, nec
Food Stores	5411	Grocery Stores
Holding and Other Investment Offices	6799	Investors, nec
Business Services	7389	Business Services, nec
	7399	Business Services, nec (7399)
Automotive Repair, Services, and Parking	7532	Top & Body Repair & Paint Shops
Engineering, Accounting, Research, Management, and Related Services	8711	Engineering Services
	8731	Commercial Physical Research
	8733	Noncommercial Research Organizations
Justice, Public Order, and Safety	9223	Correctional Institutions

Industry Group	SIC Code	SIC Code Description
Administration of Environmental Quality and Housing Programs	9511	Air and Water Resource and Solid Waste Management
Administration of Economic Programs	9661	Space Research and Technology
National Security and International Affairs	9711	National Security

Appendix D

Allocation Methods Used in the 1996 Area Source NTI for National-Level Emissions

This appendix briefly describes the various methods (referred to as allocation schemes) used in the NTI to allocate national-level area source emissions to the county level. National-level emissions were assigned to individual counties using various surrogate approaches. Some examples of the surrogate approaches used include apportioning national-level emissions to counties based on population, apportioning emissions from some industrial sectors to counties based on Standard Industrial Classification (SIC) code employment estimates, and assigning emissions from forest fires to counties based on forested acres.

Table D-1 summarizes the allocation schemes used to allocate national-level area source emissions in the 1996 area source inventory. Table D-2 lists specific details for the allocation of emissions to individual counties for each source category with national-level emission estimates. SIC codes and groups used for allocation are listed in Table D-3. Figure D-1 depicts the approach used for each allocation scheme.

Table D-1

**Summary of Allocation Schemes Used in the 1996 Area Source Inventory for
Source Categories with National-Level Emission Estimates**

Allocation Scheme Code	Original Emissions	Allocation Scheme Description
10	National	National emissions were allocated to regions based on regional proportion of 1990 national total wood consumption. Regional emissions were then allocated to counties based on county proportion of regional SIC code group employment for 1996.
17	National	National emissions were allocated to counties based on county proportion of national SIC code group employment for 1996.
18	National	National emissions were allocated to counties based on county proportion of 1996 national population.
21	National	National emissions were allocated to regions based on regional proportion of 1990 national wood consumption. Regional emissions were then allocated to counties based on county proportion of regional population for 1996.
22	National	National emissions were allocated to counties according to county proportion of national emissions (various base year activity listed in Table D-2).
27	National	National emissions were allocated to state based on state proportion of national value. State emissions were then allocated to counties based on county proportion of state value (various base year activity listed in Table D-2).

Table D-2

**Description of Allocation Schemes and Activity Data Used in the
1996 Area Source Inventory for Source Categories
With National-Level Emission Estimates**

Source Category Name	Allocation Scheme	Activity Data or Other Information Used in Allocation Scheme
Animal Cremation	17	County proportion of national 1996 County Business Patterns (CBP) employment for SIC code 0750: Animal Services, Except Veterinary. ^a
Asphalt Concrete Manufacturing	17	County proportion of national 1996 CBP employment for SIC code 2951: Asphalt paving mixtures and blocks. ^a
Asphalt Paving: Cutback Asphalt	18	County proportion of national 1996 population estimate. ^b See Appendix A for details.
Asphalt Roofing Manufacturing	17	County proportion of national 1996 CBP employment for SIC code 2952: Asphalt felts and coatings. ^a
Autobody Refinishing Paint Application	17	County proportion of national 1996 CBP employment for SIC code 7532: Top & Body Repair & Paint Shops. ^a
Aviation Gasoline Distribution: Stage I & II	18	County proportion of national 1996 population estimate. ^b
Chromic Acid Anodizing Plating	17	County proportion of national 1996 CBP employment for SIC code 3471: Plating and polishing. ^a
Consumer Product Usage	18	County proportion of national 1996 population estimate. ^b
Decorative Chromium Electroplating	17	County proportion of national 1996 CBP employment for SIC code 3471: Plating and polishing. ^a
Dental Preparation and Use	17	County proportion of national 1996 CBP employment for SIC code 8072: Dental Laboratories. ^a
Drum and Barrel Reclamation	22	Facility proportion of national activity from facility list obtained from the 112(c)(6) report. ^c
Dry Cleaning (Petroleum Solvent)	17	County proportion of national 1996 CBP employment for SICGROUP=DRYCLEAN. ^a
Flexible Polyurethane Foam Fabrication Operations	17	County proportion of national 1996 CBP employment for SIC code 3086: Plastics foam products. ^a
Flexible Polyurethane Foam Production	22	Facility proportion of national activity from 1993 facility list provided by ESD.
Fluorescent Lamp Recycling	18	County proportion of national 1996 population estimate. ^b

Table D-2**Continued**

Source Category Name	Allocation Scheme	Activity Data or Other Information Used in Allocation Scheme
Food and Agricultural Products: Cotton Ginning	22	County proportion of national 1990 PCBEIS agricultural cotton ("Cott") acres ("national" total is only for primary states producing cotton: AR, CA, LA, MS, and TX). ^d
Gasoline Distribution Stage I	17	County proportion of national 1996 CBP employment for SIC code 5171: Petroleum bulk stations and terminals. ^a
Gasoline Distribution Stage II	18	County proportion of national 1996 population estimate.
General Laboratory Activities	18	County proportion of national 1996 population estimate.
Geothermal Power	22	Facility proportion of national activity from geothermal power facility list obtained from the "Mercury Report to Congress." ^e
Halogenated Solvent Cleaners	17	County proportion of national 1996 CBP employment for SICGROUP=COMMIND. ^a
Hard Chromium Electroplating	17	County proportion of national 1996 CBP employment for SIC code 3471: Plating and polishing. ^a
Hazardous Waste Incineration	22	Facility proportion of national activity from 1997 facility list obtained from the Office of Solid Waste. ^f
Hospital Sterilizers	17	County proportion of national 1996 CBP employment for SIC code 8060: Hospitals. ^a
Human Cremation	18	County proportion of national 1996 population estimate. ^b
Industrial Boilers: Distillate Oil	17	County proportion of national 1996 CBP employment for SICGROUP=IND. ^a
Industrial Boilers: Natural Gas	17	County proportion of national 1996 CBP employment for SICGROUP=IND. ^a
Industrial Boilers: Residual Oil	17	County proportion of national 1996 CBP employment for SICGROUP=IND. ^a
Industrial Boilers: Waste Oil	17	County proportion of national 1996 CBP employment for SICGROUP=IND. ^a
Institutional/Commercial Heating: Coal	17 and 22	County proportion of national 1996 CBP employment for SICGROUP=COMM (national total based only on counties identified from independent ICCR facility list of area sources). ^a
Institutional/Commercial Heating: Distillate Oil	17	County proportion of national 1996 CBP employment for SICGROUP=COMM. ^a

Table D-2**Continued**

Source Category Name	Allocation Scheme	Activity Data or Other Information Used in Allocation Scheme
Institutional/Commercial Heating: Natural Gas	17	County proportion of national 1996 CBP employment for SICGROUP=COMM. ^a
Institutional/Commercial Heating: Publicly Owned Treatment Works (POTW) Digester Gas	18	County proportion of national 1996 population estimate. ^b
Institutional/Commercial Heating: Residual Oil	17	County proportion of national 1996 CBP employment for SICGROUP=COMM. ^a
Institutional/Commercial Heating: Wood/Wood Residue	10 and 22	Regional proportion of national 1990 total wood consumption and county proportion of national 1996 CBP SIC code employment for SICGROUP=COMM (regional total based only on counties identified from independent Industrial Combustion Coordinated Rulemaking [ICCR] facility list of area sources). ^a
Lamp Breakage	18	County proportion of national 1996 population estimate. ^b
Miscellaneous Organic Chemical Processes - Continuous Processes	17	County proportion of national 1996 CBP employment for SICGROUP=MISORGCH. ^a
Natural Gas Transmissions and Storage	17	County proportion of national 1996 CBP employment for SIC code 4920: Gas production and distribution. ^a
Oil and Natural Gas Production	17	County proportion of national 1996 CBP employment for SIC code 1310: Crude Petroleum and Natural Gas. ^a
Open Burning: Forest and Wildfires	22	County proportion of national 1990 PCBEIS ^a forested acres (adjusted for 1996 county definitions). ^d
Open Burning: Prescribed Burnings	27	State proportion of national 1996 acres burned and county proportion of state 1990 PCBEIS forested acres (adjusted for 1996 county definitions). ^d
Open Burning: Scrap Tires	22	County proportion of national 1996 population estimate ONLY for counties with landfills as reported in the "Directory and Atlas of Solid Waste Disposal Facilities 1997-1998." ^g
Paint Stripping Operations	18	County proportion of national 1996 population estimate. ^b
Perchloroethylene (PERC) Dry Cleaning	17	County proportion of national 1996 CBP employment for SICGROUP=DRYCLEAN. ^a
Pesticide Application	22	County proportion of national 1990 PCBEIS agricultural acres (adjusted for 1996 county definitions). ^d

Table D-2**Continued**

Source Category Name	Allocation Scheme	Activity Data or Other Information Used in Allocation Scheme
Polyvinyl Chloride and Copolymer Production	17	County proportion of national 1996 CBP employment for SIC code 2821: Plastics materials and resins. ^a
Publicly Owned Treatment Works (POTWs)	18	County proportion of national 1996 population estimate. ^b
Refractories Manufacturing	22	Facility proportion (even distribution to all facilities) of national activity from 1997 facility list.
Residential Heating: Anthracite Coal	18	County proportion of national 1996 population estimate. ^b
Residential Heating: Bituminous and Lignite Coal	18	County proportion of national 1996 population estimate. ^b
Residential Heating: Distillate Oil	18	County proportion of national 1996 population estimate. ^b
Residential Heating: Natural Gas	18	County proportion of national 1996 population estimate. ^b
Residential Heating: Wood/Wood Residue	21	Regional proportion of national 1990 residential wood consumption and county proportion of regional 1996 population estimate. ^b
Softwood Drying Kilns	17	County proportion of national 1996 CBP employment for SIC code 2421: Sawmills and planing mills, general. ^a
Steel Pickling Hydrogen Chloride (HCl) Process	17	County proportion of national 1996 CBP employment for SIC code 3312: Blast furnaces and steel mills. ^a
Structure Fires	18	County proportion of national 1996 population estimate. ^b
Surface Coating Operations: Traffic Markings	27	State proportion of 1996 national disbursements and county proportion of state 1996 population estimate. ^h
Surface Coating Operations: Industrial Maintenance Coatings	17	County proportion of national 1996 CBP employment for SICGROUP=IND. ^a
Surface Coating Operations: Architectural	18	County proportion of national 1996 population estimate. ^b
Taconite Iron Ore Processing	17	County proportion of national 1996 CBP employment for SIC code 1010: Iron ores. ^a

Table D-2

Continued

- ^a County Business Patterns 1996. United States Department of Commerce, Bureau of the Census. CBP-96-1. November 1998.
- ^b Estimates of the Population of Counties: Annual Time Series, July 1, 1990 to July 1, 1997 (includes revised April 1, 1990 census population counts). CO-97-4. Population Estimates Program, Population Division. U.S. Bureau of the Census, Washington, D.C.
- ^c U.S. Environmental Protection Agency. 1990 Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD)/ 2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead. Final Report. Research Triangle Park, North Carolina. June 1997.
- ^d The Personal Computer Biogenic Emissions Inventory System (PCBEIS) was developed by EPA, and is available at: <http://www.epa.gov/ttn/chief/software.html>.
- ^e U.S. Environmental Protection Agency. "Mercury Report to Congress, Volume I: Executive Summary." Office of Air Quality Planning and Development. December 1997. Pp. 4-74 through 4-77.
- ^f F. Behan, Office of Solid Waste. U.S. Environmental Protection Agency. Database of Hazardous Waste Incineration Emissions Data. March 1999.
- ^g The Directory and Atlas of Solid Waste Disposal Facilities 1997-1998. Fourth Edition, Chartwell Information Publishers, Alexandria, VA 1998.
- ^h Total Disbursements for Highways, All Units of Government - 1996. Table HF-2. United States Department of Transportation. October 1998. Source: <http://search.bts.gov/ntl/query.html>.

Table D-3

**List of SIC Codes and SIC Groups Used
in NTI Allocation Schemes 10 and 17**

SIC Code or SIC Group Code	Individual SIC Code or SIC Group Description from 1996 County Business Patterns SIC Reference File (Includes Broad Component SIC Definitions for Groups)
0750	Animal services, except veterinary
1010	Iron ores
1310	Crude petroleum and natural gas
2421	Sawmills and planing mills, general
2821	Plastics materials and resins
2910	Petroleum refining
2951	Asphalt paving mixtures and blocks
2952	Asphalt felts and coatings
3086	Plastics foam products
3312	Blast furnaces and steel mills
3471	Plating and polishing
4920	Gas production and distribution
5171	Petroleum bulk stations and terminals
7532	Top and body repair and paint shops
8060	Hospitals
8072	Dental laboratories
COMM	<p>Commercial Sector (50-89): 50-- (WHOLESALE TRADE) 52-- (RETAIL TRADE) 60-- (FINANCE, INSURANCE, AND REAL ESTATE) 70-- (SERVICES) except: 519\ (Administrative and auxiliary for 50--) 599\ (Administrative and auxiliary for 52--) 679\ (Administrative and auxiliary for 60--) 899\ (Administrative and auxiliary for 70--)</p>

Table D-3

Continued

SIC Code or SIC Group Code	Individual SIC Code or SIC Group Description from 1996 County Business Patterns SIC Reference File (Includes Broad Component SIC Definitions for Groups)
COMMIND	<p>Commercial Sector (50-89)/Manufacturing Sector (20-39) and Electric, Gas, and Sanitary Services (49):</p> <p>50-- (WHOLESALE TRADE)</p> <p>52-- (RETAIL TRADE)</p> <p>60-- (FINANCE, INSURANCE, AND REAL ESTATE)</p> <p>70-- (SERVICES)</p> <p>except:</p> <p>519\ (Administrative and auxiliary for 50--)</p> <p>599\ (Administrative and auxiliary for 52--)</p> <p>679\ (Administrative and auxiliary for 60--)</p> <p>899\ (Administrative and auxiliary for 70--)</p> <p>20-- (MANUFACTURING)</p> <p>4900 (Electric, gas, and sanitary services)</p> <p>except:</p> <p>399\ (Administrative and auxiliary for 20--)</p> <p>497\ (Administrative and auxiliary for 4900)</p>
DRYCLEAN	<p><u>Dry Cleaning Industry:</u></p> <p>7215 (Coin-operated laundries and cleaning)</p> <p>7216 (Dry cleaning plants except rug)</p> <p>7218 (Industrial launderers)</p>
IND	<p><u>Manufacturing Sector (20-39) and Electric, Gas, and Sanitary Services (49):</u></p> <p>20-- (MANUFACTURING)</p> <p>4900 (Electric, gas, and sanitary services)</p> <p>except:</p> <p>399\ (Administrative and auxiliary for 20--)</p> <p>497\ (Administrative and auxiliary for 4900)</p>
MISORGCH	<p>2820 (Plastics materials and synthetics)</p> <p>2840 (Soap, cleaners, and toilet goods)</p> <p>2850 (Paints and allied products)</p> <p>2860 (Industrial organic chemicals)</p> <p>2870 (Agricultural chemicals)</p> <p>2890 (Miscellaneous chemical products)</p> <p>3860 (Photographic equipment and supplies)</p>

Notes:

- (1) Dashes ("--") are used to represent any or all numbers from 0 to 9, and represent summations up to the non-dashed numbers indicated.
- (2) Back slashes ("\") are used to represent the auxilliary or administrative services portion of an SIC grouping.

Figure D-1

Diagram and Calculations for Allocation Schemes Used in the NTI

Allocation Scheme: 10

Given:

National
Emissions



Calculate:

$$\text{Regional Emissions} = \frac{\text{Regional Wood Consumption}}{\text{National Wood Consumption}} \times \text{National Emissions}$$



Calculate:

$$\text{County Emissions} = \frac{\text{County SIC Employment}}{\text{Regional SIC Employment}} \times \text{Regional Emissions}$$

Allocation Scheme: 17

Given:

National
Emissions



Calculate:

$$\text{County Emissions} = \frac{\text{County SIC Employment}}{\text{National SIC Employment}} \times \text{National Emissions}$$

Allocation Scheme: 18

Given:

National
Emissions



Calculate:

$$\text{County Emissions} = \frac{\text{County Population}}{\text{National Population}} \times \text{National Emissions}$$

Allocation Scheme: 21

Given:

National
Emissions



Calculate:

$$\text{Regional Emissions} = \frac{\text{Regional Wood Consumption}}{\text{National Wood Consumption}} \times \text{National Emissions}$$



Calculate:

$$\text{County Emissions} = \frac{\text{County Population}}{\text{Regional Population}} \times \text{Regional Emissions}$$

Figure D-1

Continued

Allocation Scheme: 22

Given:

National
Emissions



Calculate:

County Emissions = County Proportion of National Value × National Emissions

Allocation Scheme: 27

Given:

National
Emissions



Calculate:

State Emissions = State Proportion of National Value × National Emissions



Calculate:

County Emissions = County Proportion of State Value × State Emissions